

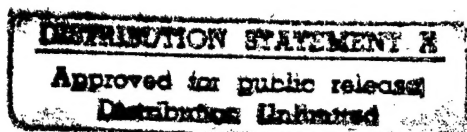
1993 Report to the Congress on the

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Table Of Contents

List of Figures.....	vii
List of Tables.....	viii

Chapter 1

Ballistic Missile Defense Policy

1.0	Introduction.....	1-1
1.1	Background.....	1-1
1.2	Missile Defenses In U.S. Military Strategy.....	1-2
1.2.1	Strategic Deterrence And Defense.....	1-3
1.2.2	Forward Presence.....	1-3
1.2.3	Crisis Response.....	1-3
1.2.4	Force Reconstitution.....	1-4
1.3	The Ballistic Missile Threat.....	1-4
1.3.1	Accidental And Unauthorized Strikes.....	1-4
1.3.2	Ballistic Missile Proliferation.....	1-4
1.4	Building A Consensus On Ballistic Missile Defenses.....	1-5
1.4.1	Challenge From President Yeltsin On Missile Defenses.....	1-5
1.4.2	The ABM Treaty.....	1-9
1.4.3	United States And Its Allies.....	1-10
1.4.4	The Global Protection System Concept.....	1-11
1.4.5	The Missile Defense Act.....	1-12
1.5	Theater Missile Defense Initiative.....	1-13
1.6	Deployment Planning.....	1-13
1.7	Summary And Conclusions.....	1-14

Chapter 2

Strategy And Objectives

2.1	Introduction.....	2-1
2.1.1	Revisions To The Missile Defense Act.....	2-2
2.1.2	Programmatic Realignment For LDS.....	2-4
2.1.3	Programmatic Realignment Of Follow-on Activities.....	2-6
2.1.4	Overall LDS Program Strategy.....	2-6
2.2	The Limited Defense System.....	2-6
2.2.1	The Initial Site Of The Limited Defense System - Core Program.....	2-6
2.2.2	The UOES Option.....	2-16
2.2.3	Cost Of The Initial Site.....	2-16
2.2.4	Completing The Limited Defense System.....	2-17
2.3	Technology Development Supporting LDS.....	2-17
2.3.1	Near Term Activities.....	2-17
2.3.2	Follow-on Activities.....	2-19
2.3.3	Congressional Direction Relating To Far-term Activities.....	2-21
2.4	Management Approach.....	2-22
2.5	Conclusion.....	2-22

Chapter 3

Program Element Descriptions

3.1	Introduction.....	3-1
3.2	SDI Program Elements.....	3-1
3.2.1	Program Element: 0603215C Limited Defense System.....	3-1
3.2.2	Program Element: 0603214C Space-based Interceptors.....	3-2
3.2.3	Program Element: 0603217C Other Follow-on Systems.....	3-2

3.2.4	Program Element: 0603218C	
	Research And Support Activities.....	3-3
3.2.5	Program Element Status Summary.....	3-3

Chapter 4

Program Funding

4.1	Introduction.....	4-1
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Chapter 5

ABM Treaty Compliance

5.1	Introduction.....	5-1
5.2	Existing Compliance Process For SDI.....	5-2
5.3	SDI Experiments.....	5-3

Chapter 6

Other Nation Participation

6.1	Consultations.....	6-1
6.2	Research Participation.....	6-1
6.3	Summary Of Past, Present And New Efforts.....	6-1
6.4	Summary Of Participation.....	6-3

Chapter 7

Countermeasures

7.1	Introduction.....	7-1
7.2	The Commonwealth Of Independent States.....	7-1
7.3	Countermeasures Evaluation And Verification.....	7-2
7.4	Summary And Conclusions.....	7-2

Chapter 8

Relation Of SDI Technologies To Military Missions

8.1	Introduction.....	8-2
8.2	SDI Technologies And Illustrative Military Missions.....	8-2
8.2.1	Air Defense.....	8-2
8.2.2	Maritime Operations.....	8-3
8.2.3	Ground Forces.....	8-4
8.2.4	Space Defense.....	8-5
8.3	Cost Effectiveness At The Margin.....	8-5
8.4	Survivability.....	8-6

Appendix

Programs, Projects, And Activities – Narrative Description And Status

List Of Figures

Figure 1-1	The Current Third Country Ballistic Missile Capability.....	1-7
Figure 2-1	FY 93 Strategic Defense Budget History.....	2-3
Figure 2-2	Core SDIO LDS Program.....	2-5
Figure 2-3	Strategic Defense Architecture Concepts.....	2-7
Figure 2-4	Limited Defense System Deployment Plan.....	2-8
Figure 2-5	LDS Acquisition Strategy.....	2-10
Figure 2-6	Initial Site.....	2-11
Figure 2-7	Limited Defense System.....	2-18
Figure 2-8	Follow-on.....	2-19

List Of Tables

Table 3-1	Correlation Of GPALS Functional Areas And SDI Program Support Activities With Projects, Program Elements, And Possible Deployment Phases.....	3-4
Table 3-2	Program Element Key Activities.....	3-6
Table 3-3	Estimated Funding Required To Meet Next Milestone.....	3-9
Table 4-1	Project Funding Profile.....	4-2

Chapter 1

Ballistic Missile Defense Policy

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Chapter 1

Ballistic Missile Defense Policy

1.0 Introduction

Two years have passed since President Bush directed that the SDI program be refocused on providing a missile defense system to protect the United States, its forces deployed abroad, and its friends and allies against accidental, unauthorized, and/or limited ballistic missile strikes. During this time, international events such as the Gulf War Scud attacks, the break up of the Soviet Union, and continuing proliferation of ballistic missiles and weapons of mass destruction have validated the President's decision. The Missile Defense Act exhibits the growing bipartisan consensus on our fundamental missile defense goals and on an acquisition strategy for achieving our missile defense goals. Discussions with Russia and our Allies on moving toward a cooperative Global Protection System are showing both progress and promise.

1.1 Background

In January 1991, the President redirected the SDI program away from its previous focus--deterrence of a massive Soviet ballistic missile attack--to providing protection to the United States, its forward deployed forces, and its allies and friends, against limited ballistic missile strikes, whatever their source. On the basis of that change, the United States began concentrating its ballistic missile defense activities in several broad areas.

During 1991 the role of ballistic missile defenses was identified within the new U.S. military strategy which focused on meeting regional threats and challenges; discussions were renewed with allies and friends on their participation in our ballistic missile defense program; the then-Soviet Government was approached to join us to permit the limited deployment of defenses and; a program strategy and acquisition approach was developed to support our revised policy objectives and to permit the deployment of ballistic missile defenses by the end of the decade.

Since January 1992 the United States has been developing a concept for a Global Protection System in response to Russian President Boris Yeltsin's announcement that Russia was ready to participate in a global system of defense against ballistic missiles. We also began intensive discussions with allies and friends, both individually and in multilateral fora, seeking their views on our proposed response to President Yeltsin and inviting their participation in a Global Protection System. At the June Washington Summit, the sides agreed to work together with allies and other interested states to develop a concept for a Global Protection System against limited ballistic missile attack and to develop the legal basis necessary for such a system. Presidents Bush and Yeltsin also agreed to appoint representatives to lead a High-Level Group to develop the concept for a Global Protection System. The High-Level Group conducted detailed and constructive meetings in July and again in September, which reflected the new strategic relationship. Subsequently, working groups were convened in October to begin working on the means and methods for implementing a Global Protection System. The United States is continuing discussions with the Russians and our allies and friends to consolidate progress toward the implementation of a concept for a Global Protection System.

Ballistic Missile Defense Policy

And finally, we have worked to implement Congressional direction detailed in relevant legislation. A consensus has been established between the Congress and the Executive Branch on the role of missile defense in protecting the U.S., its friends and allies, and our forces abroad against limited ballistic missile attacks. As set forth in the 1991 Missile Defense Act and its amendment in the FY 1993 Defense Authorization Act, the Department is planning with Congressional approval to deploy the initial (UOES)¹ elements of advanced theater missile defenses by the mid-1990s and to provide an option to deploy an Anti-ballistic Missile (ABM) Treaty compliant defense (UOES) located at a single site around the turn of the decade as the initial step toward a highly effective defense of the United States.

1.2 Missile Defenses In U.S. Military Strategy

As described in the May 1991 and July 1992 Report To Congress on the Strategic Defense Initiative and other Departmental reports, the President's decision to refocus the SDI program was based on almost two years of intensive review of the changing international security environment. This new defense concept stressed continuous protection of the U.S., its forces abroad and allies against limited ballistic missile strikes, whatever their source. The rationale for the refocused program was twofold:

- First, while changes in the East-West relationship reduced the risk of conventional and nuclear war with the Soviet Union, political instability in the then-Soviet Union caused concern over the potential for accidental or unauthorized use of ballistic missiles.
- Second, concern about the increasing proliferation of ballistic missiles and weapons of mass destruction throughout the Third World and the growing threat that these weapons would be used in regional conflicts.

The program elements in SDIO that related to this concept were grouped together under the title GPALS, for Global Protection Against Limited Strikes. The purpose of a GPALS system is to protect, on a continuous basis, the American people and U.S. worldwide interests against both strategic and theater range threats. We are designing the defense to meet a threshold requirement to protect against ballistic missile threats of up to a few tens of warheads, with an objective of high confidence of very low or no leakage against up to 200 attacking ballistic missile warheads in a variety of scenarios.

Ballistic missile defense contributes to U.S. military strategy in a number of critical areas, including strategic deterrence and defense; forward presence; crisis response; and reconstitution.

¹The User Operational Evaluation System (UOES) can best be thought of as exploiting operational assessment prototypes, providing, in case of an urgent operational need, a "system" capability during the demonstration and validation stage of development. While the UOES undergoes field testing and early operational assessment, the underlying or core acquisition program continues through the engineering and manufacturing development phase.

1.2.1 Strategic Deterrence and Defense

The United States will continue to rely on its strategic nuclear deterrent capability, including a survivable command, control, and communications system and a modified version of the traditional nuclear Triad. Ballistic missile defenses--including space- and ground-based interceptors and sensors--will provide protection for the United States against actions that are by definition undeterrable--accidental and unauthorized launches. They also can provide protection against limited, deliberate ballistic missile strikes which may threaten regional stability or the interests of U.S. allies and friends. Ballistic missile defenses could extend protection to our forward deployed forces and allies. Defenses will become an increasingly important indicator of American strategic capability and military strength--a tangible sign that we remain committed to providing security assistance to our friends and allies.

1.2.2 Forward Presence

The forward presence of U.S. forces can take many forms. Stationing forces in selected forward bases or aboard naval vessels is perhaps the most visible demonstration of U.S. commitment in key areas. Theater ballistic missile defense systems operating in concert with U.S. early warning systems will provide point and wide area defense and early warning to U.S. forward-based and expeditionary forces; space-based interceptors could provide continuous, global coverage against tactical missiles that exit the atmosphere for those forces against longer-range theater ballistic missiles. U.S. defenses, in combination with those its allies and coalition partners might deploy, would provide protection, on short notice, of U.S. forces, host nation forces, and ports and airfields for arriving forces. These defenses would also be capable of protecting population centers and would permit those at risk additional warning to undertake civil defense measures. Such a capability will become increasingly vital to the U.S. leadership role in the world as ballistic missiles proliferate and aggressors attempt to deter the formation of defensive coalitions through the threat of missile attacks.

1.2.3 Crisis Response

The need to respond to regional contingencies and crises, and do so on very short notice, is one of the key elements of the new regional strategy. Defenses, in addition to protecting targets, could also serve to defuse regional crises by deterring the employment of ballistic missiles. This combination of defense and deterrent capabilities increases the likelihood that, in regional crises, potential adversaries could not use ballistic missile attacks to gain an advantage or to deter the United States and its allies or coalition partners from pursuing political, diplomatic, or military initiatives designed to resolve a crisis. By thus reducing the military utility of ballistic missiles, such defenses would contribute directly to the accomplishment of U.S. non-proliferation objectives.

Active defenses² can also reduce pressures on U.S. military and political leaders involved in a regional conflict to alter their campaign or war plans because of the threat (or actual use) of ballistic missiles. In the absence of effective defenses, carefully laid plans could be disrupted or delayed. With an effective defense in place, our military leaders are better able to execute their well-constructed plans, thereby retaining the initiative in battle.

²In addition to active defense, the Theater Missile Defense mission is comprised of counterforce or attack operations; passive defense; and battle management / command, control, communications and intelligence. Further details of the Department's TMD plans are addressed in the TMDI Report To Congress.

1.2.4 Force Reconstitution

The reconstitution concept is not simply to recreate or expand existing forces, but to consider what new forces are most needed to meet a new or reemerging threat consistent with U.S. strategy. The capability to protect against limited strikes represents an appropriate level of defense within our strategic forces structure, based on our current planning assumptions. Forces under consideration for deployment in the GPALS concept should provide the base level of capability to carry us into the foreseeable future in support of our forward presence and crisis response missions. If more ambitious missile defense capabilities are required in the future as a result of changes in the international environment, the SDI program will have developed the systems and technologies required to respond, should a decision be made to do so in the future.

1.3 The Ballistic Missile Threat

1.3.1 Accidental and Unauthorized Strikes

With the collapse of the Soviet Union the danger of a large scale war in Europe leading to nuclear conflict has vastly diminished. Nonetheless, the end of the Cold War confronts us with new challenges. The states of the former Soviet Union face internal crises and the possibility of civil disorder, while they continue to possess thousands of strategic and tactical nuclear warheads. While the strong central government of the former Soviet Union had a robust nuclear command and control system that provided us with high assurance that an accidental or unauthorized launch was highly unlikely, this command and control system was not designed in anticipation of the dissolution of the Soviet Union and the potential fragmentation of political and military authority. While the U.S. intelligence community believes an accidental or unauthorized launch remains unlikely, the dramatic political changes in this region could betray weaknesses in Russia's command and control system that neither we nor the Russians could have anticipated and has resulted in heightened concern over this risk.

Political turmoil in the former Soviet Union, however, is not the only reason for concern about accidental and unauthorized strikes. The ability of ballistic missile proliferators to maintain command and control of the modern weapons they are acquiring is questionable. Command and control of these systems is technically demanding and it is unclear that appropriate communications networks, safeguards, and clearly delineated decision-making authority will exist to prevent accidental or unauthorized use of the weapons by these third countries.

1.3.2 Ballistic Missile Proliferation

Ballistic missile defenses will support our broader efforts to discourage the spread of ballistic missile technologies and weapons of mass destruction by providing a means to deter the use of such weapons. Should deterrence fail and ballistic missiles be used against the U.S., its forces, or our friends and allies, missile defenses would be able to destroy the attacking missiles. In this way, missile defenses would help undermine the military and political utility of such systems, and discourage countries from acquiring them.

Ballistic missiles continue to be deployed in areas beset with regional conflicts, particularly in the Middle East and Southwest Asia -- regions where ballistic missiles have been used in four of the last six major wars. A major implication for future regional contingencies that clearly emerged

from the Gulf War is the political and military importance of possessing a capability to counter defensively the threatened or actual use of ballistic missiles and weapons of mass destruction. The United States cannot accept a situation in which these capabilities are allowed to constrain a U.S. President's flexibility in employing military power when necessary to support U.S. national security objectives and commitments abroad.

Today, over 20 non-NATO nations have ballistic missile capabilities (See Figure 1-1). Many of the countries that are developing and/or acquiring ballistic missiles are also acquiring weapons of mass destruction. These weapon systems pose a threat today that is largely regional in character. However, the trend is clearly in the direction of systems of increasing range, lethality, and sophistication. Several nations with space launch capabilities could modify those launchers to acquire a long-range ballistic missile capability. In the past, space launch capabilities emerged simultaneously with ballistic missile achievements. Historically, when a country decided to build an SLV, it generally derived the initial version from a ballistic missile.

After the turn of the decade, some nations hostile to the U.S. could acquire ballistic missiles that could threaten the United States. Over the next ten years we are likely to see several Third World nations establish the infrastructure and develop the technical knowledge required to undertake ICBM and space launch vehicle development, although testing and production of these missile systems would take some time.

Through purchase of entire weapons and long-range delivery systems, nations that are potentially hostile to the U.S. could quickly acquire the means of attacking the continental United States. Also, the sale of production technology and technical expertise can significantly shorten development time. Attempts to control this spread are challenged by the already widespread availability of ballistic missile technology. Significant technical data is available from open source literature and many of the necessary technologies and techniques have been around for several decades. Some of the trade in ballistic missiles and their technology remains essentially outside the bounds of existing control mechanisms.

1.4 Building A Consensus On Ballistic Missile Defenses

The United States has been working intensively in several areas to develop the foundation--both nationally and internationally--that would permit moving forward on our goals for ballistic missile defenses. First, we have been pursuing discussions on a Global Protection System concept in detail with the Russian Government. Second, we have been involved in frequent consultations with our allies and other states on the concept for a Global Protection System and we have kept them fully informed of our discussions with the Russians. And finally, we have worked to implement the Missile Defense Act.

1.4.1 Challenge from President Yeltsin on Missile Defenses

Following the President's decision in 1991 to refocus the SDI program, the United States began a review of U.S.-Soviet arms control objectives. This resulted in President Bush's September 27, 1991 call "on the Soviet leadership to join us in taking immediate, concrete steps to permit the limited deployment of non-nuclear defenses to protect against limited ballistic missile strikes--

Ballistic Missile Defense Policy

whatever their source." Several days later, on October 3, the U.S. presented a new proposal in the Defense and Space Talks (DST), which was consistent with our GPALS concept. On October 5, 1991, then-president Gorbachev signaled a clear change of previous Soviet thinking on this issue when he replied to the President's invitation by stating that "we are ready to discuss the U.S. proposal on non nuclear ABM systems." In meetings in October and November, U.S. representatives met with senior representatives of the Soviet Union, Russia, Ukraine, Belarus, and Kazakhstan and explained in detail our concept for limited ballistic missile defense. We also discussed the possibility of defense cooperation in response to former President Gorbachev's July proposal to the leaders of the G-7 for "development of joint ABM early warning systems to prevent unauthorized or terrorist operated launches of ballistic missiles."

President Bush's initiative for cooperation in the deployment of defenses was followed by President Yeltsin's January 29, 1992 announcement that "We are ready jointly to work out and subsequently to create and jointly operate a global system of defense in place of SDI." Two days later, in a speech to the United Nations Security Council, President Yeltsin reiterated his proposal for the "creation of a global system for protection of the world community" which "could make use of high technologies developed in Russia's defense complex." President Yeltsin's remarks represented a major breakthrough. For the first time, a Russian leader publicly acknowledged a shared interest in developing defenses against ballistic missiles while at the same time calling for further reductions in offensive nuclear weapons - breaking with former arguments that defenses are not compatible with offensive reductions.

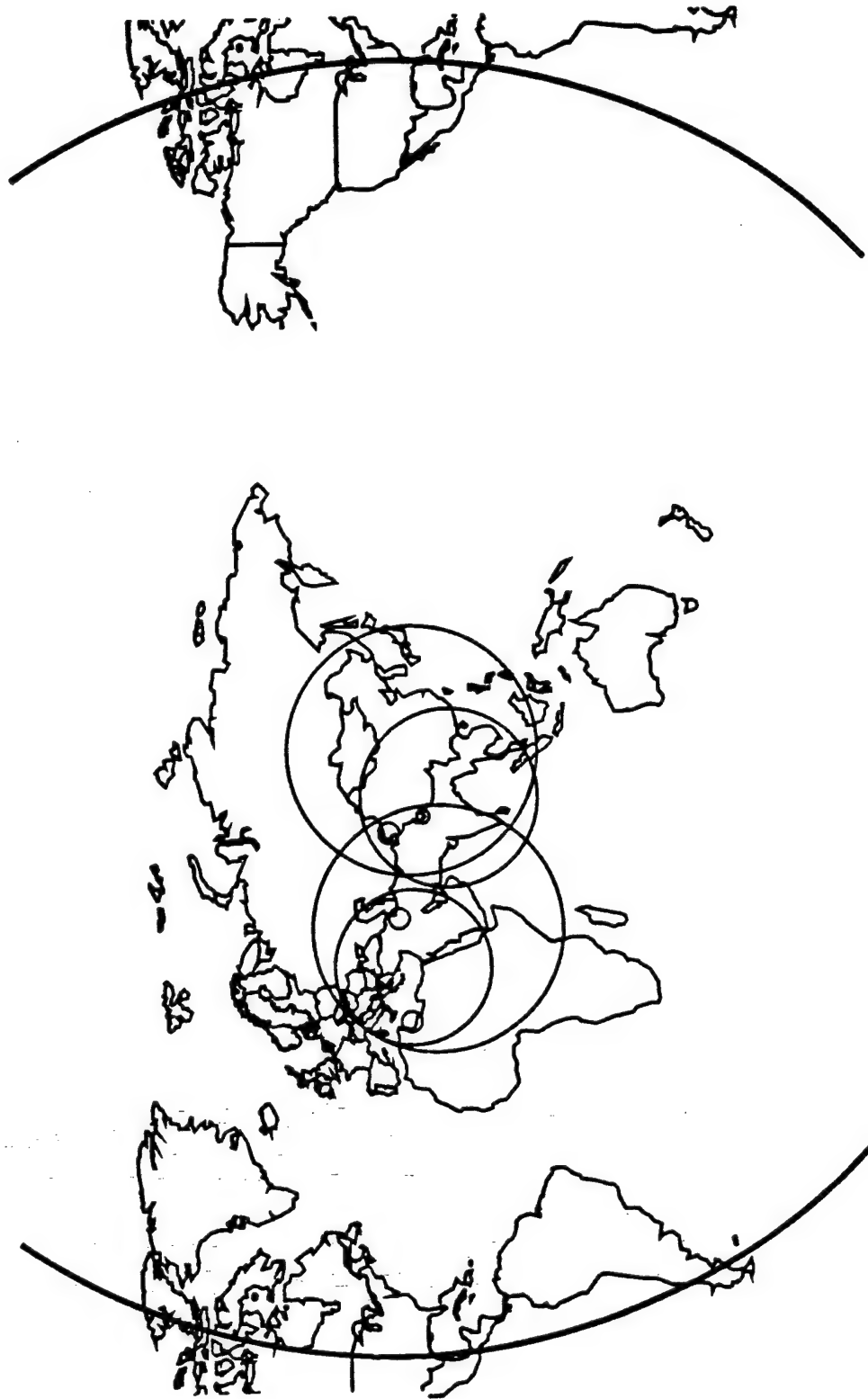
During their meeting at Camp David on February 1, Presidents Bush and Yeltsin had a constructive discussion about the proposal on global defenses. They agreed to continue this dialogue. When Secretary of State Baker met in Moscow in February with President Yeltsin and Foreign Minister Kozyrev, he stated that the U.S. shared Yeltsin's bold vision on the need for a global ballistic missile defense system, and that we were prepared to work together toward this goal. Secretary Baker proposed that we begin this cooperation by concrete steps in three areas:

- The sharing of early warning information on ballistic missile launches through a Joint Ballistic Missile Early Warning Center that would integrate and display early warning information from all participants;
- The discussion of areas for possible technology exchange, especially the acquisition of former Soviet technology and hardware; and,
- The development of a concept for a global ballistic missile defense system.

At the June 16-17 Summit in Washington, Presidents Bush and Yeltsin issued a Joint Statement on a Global Protection System:

"The Presidents continued their discussion of the potential benefits of a Global Protection System (GPS) against ballistic missiles, agreeing that it is important to explore the role for defenses in protecting against limited ballistic missile attacks. The two Presidents agreed that their two nations should work together with allies and other interested states in developing a concept for

Figure 1-1. The Current Third Country Ballistic Missile Capability



Ballistic Missile Defense Policy

such a system as part of an overall strategy regarding the proliferation of ballistic missiles and weapons of mass destruction. Such cooperation would be a tangible expression of the new relationship that exists between Russia and the United States and would involve them in an important undertaking with other nations of the world community. The two Presidents agreed it was necessary to start work without delay to develop the concept of the GPS. For this purpose they agreed to establish a high-level group to explore on a priority basis the following practical steps:

- The potential for sharing early warning information through the establishment of an early warning center.
- The potential for cooperation with participating states in developing ballistic missile defense capabilities and technologies.
- The development of a legal basis for cooperation, including new treaties and agreements and possible changes to existing treaties and agreements necessary to implement a Global Protection System."

The High Level Group first met in July and again in September. During the 13-14 July meeting in Moscow, both sides outlined their broad positions on a concept for a Global Protection System. They also agreed to establish three working groups to further develop the concept: a Concept Working Group; a Technology Cooperation Working Group; and a Non-Proliferation Working Group. The High Level Group retained responsibility for discussing the legal issues associated with moving toward a Global Protection System.

During the September meeting of the High Level group in Washington, the two sides addressed four topics: 1) technology cooperation, 2) non-proliferation activities, 3) further elaboration of the Global Protection System concept and 4) further discussion about the issues associated with the legal basis for a global protection system. At the conclusion of the meetings, the sides agreed that the Working Groups would begin work to "develop the means and methods for implementing" a Global Protection System.

The Non-proliferation Working Group began its first meeting in Moscow on October 5th. They began a candid and comprehensive dialogue on non-proliferation issues, including the problem of ballistic missile proliferation and the role of defenses in addressing this problem.

The Concept Working Group on a GPS met for the first time in Moscow October 27-30 while the Technology Cooperation Working Group met October 29-30. The U.S. and Russia exchanged detailed presentations and conducted extensive discussions on a wide range of issues related to establishing a GPS. The agenda included discussion of the overall GPS concept, the strategic dimension of the ballistic missile threat, command and control issues associated with a GPS, participation in a GPS, early warning information and a Global Protection Center, sensor contribution to a GPS and joint Anti-tactical Ballistic Missile (ATBM) activities. The work of the High-Level Group and its Working Groups suggest that Russian views on a number of important elements of a GPS have moved closer to those of the United States.

1.4.2 The ABM Treaty

The ABM Treaty was negotiated at the height of the Cold War. At that time, there was intense hostility between the United States and Soviet Union and high levels of defense expenditures, both offensive and defensive. Recent events have drastically changed the world security environment and have transformed the relationship between the U.S. and the countries of the Former Soviet Union (FSU) from one of competition to one of cooperation. The growing partnership between the U.S. and the FSU States including the potential for joint efforts to meet common security concerns offers the opportunity to take a thoroughly new approach to stability and to the contribution ballistic missile defenses can make. In fact, without the changed security environment, a Global Protection System would not be possible.

In light of the changed security environment and in the context of developing a concept for a Global Protection System, the U.S. has stated to the Russians that the ABM Treaty needs to be updated to reflect current realities and to implement a Global Protection System. The proposed updates would provide a clear legal basis for an effective Global Protection System. The United States has proposed updating the ABM Treaty in five ways. These are:

- First, to provide early warning and cueing information necessary for defense against ballistic missile strikes, neither sensors nor the use of the information they provide should be limited.
- Second, to allow the potential for advances in the technology to be applied in the future to increase the effectiveness and to reduce the cost of missile defenses, development and testing of ABM systems must be allowed without regard to basing mode or physical principle.
- Third, to realize the goal of a Global Protection System--to defend entire populations from limited strikes--limits on the number of deployment areas and deployed interceptors must be relaxed; the U.S. has proposed up to six ABM sites with no more than 150 ABM interceptors per site.
- Fourth, to allow deployment of fully effective ATBM systems (and their support by space-based sensors) that are necessary to defend against the existing and growing threat posed by intermediate-range ballistic missiles with weapons of mass destruction, ABM Treaty ambiguities that result in legal impediments to the development, deployment, sale, or export of ATBM systems must be clarified.
- Fifth, to provide for the exchange of technical data and hardware that would be characteristic of activities among participants in a Global Protection System, the ABM Treaty restriction on these transfers would have to be lifted.

Modification of the ABM Treaty would be in keeping with the new relationship between the U.S.

and Russia because it would clarify ambiguities and eliminate areas of contention that could lead to misunderstanding and tension between the two countries. For example, due to the improvements in technology, it will become increasingly difficult to distinguish between sensors deployed on the ground or in space for an ABM purpose and those employed for other purposes. Likewise, deployment by the U.S. or Russia of advanced ATBM systems and their support by high quality space-based sensors, which are consistent with both countries' security needs, could raise Treaty concerns and tensions because of the above-mentioned ABM Treaty ambiguities.

The updates to the ABM Treaty proposed by the U.S. would substantially resolve issues relating to succession as well as existing compliance concerns and eliminate other Treaty ambiguities which could lead to future compliance issues. For example: with the demise of the Soviet Union, certain key ABM-related facilities are now located in non-Russian states, including early warning radars, the Sary Shagan ABM test range, and ABM-associated development and production facilities. The proposed updates would resolve concerns about Large Phased Array Radar (LPAR) support of the Moscow ABM system and the ABM potential of advanced Soviet SAMs and ATBMs.

Thus, it is clear that if the ABM Treaty continues in its present form, it will not only present an obstacle to achieving the Global Protection System, but it is likely to be a source of serious contention, completely inconsistent with the cooperative relationship now developing between the U.S. and Russia.

On the future of the dialogue on GPS, the United States and Russia have seen no insurmountable problems, including the ABM Treaty, to implementation of a GPS. The Russian government has made clear its desire to continue the dialogue on the GPS concept which it views as part of a broad range of new and important contacts which will fundamentally alter the strategic relationship between Russia and the U.S. and its allies. We hope to continue these discussions even as we continue to pursue the development of a core baseline program that is ABM Treaty compliant.

1.4.3 United States And Its Allies

The U.S. has been discussing the GPALS concept with its NATO allies and other allies and friends for over two years, both bilaterally and in NATO fora. These discussions have included the objectives of a limited deployment of ballistic missile defenses--including, in our view, that such defenses would not undermine the credibility of existing deterrent capabilities--and the willingness of the U.S. to extend protection to allies. We have also discussed the possibility of providing allies information from sensors for both early warning of an attack and to improve the effectiveness of theater-based (U.S. or allied) ballistic missile defenses. Additionally, our discussions included an invitation to participate in the development and operation of those defenses. (See Chapter 6 for a discussion of allied participation in SDIO research projects.)

When President Yeltsin raised the idea of a Global Protection System in January 1992, the United States immediately began to develop a concept for a GPS and initiated discussions with our allies on our thinking on the subject. In these discussions, the United States emphasized that in its view this Global Protection System would not replace or supersede existing security arrangements or agreements; that the U.S. would do nothing with the Russians that undermine our defense commitments to our traditional allies; that not all cooperative projects undertaken with our allies will be open to Russia; and that we are prepared to include interested allies in any activity we under-

take with the Russians.

At the June 1992 Summit, Presidents Bush and Yeltsin specifically agreed to work with allies and other interested states in developing the concept for a Global Protection System. Since then, we have discussed GPS in greater detail with our friends, our allies in NATO, in the Pacific, and in Israel, and high-level representatives of Russia and other former Soviet republics. While still in the early stages of basic concept development for a GPS, the United States has discussed with our allies the three basic components of GPS: (1) sharing of early warning information; (2) planning for use of nationally controlled ballistic missile defense forces; and (3) technology cooperation. We will continue our bilateral and multilateral efforts with our allies to develop a mutually agreeable GPS.

1.4.4 The Global Protection System Concept

The United States views the GPS concept as a voluntary association of sovereign states committed to assisting one another in meeting the challenge to their national security and international stability that is posed by the proliferation of ballistic missiles and weapons of mass destruction. Participation in this system would be open to all interested states that are members in good standing of the community of nations and that have embraced the objectives of stemming the proliferation of advanced military technology.

Under this approach, the U.S. contribution to the GPS concept would be its GPALS program as described in this report. The United States would be willing to make available the benefits of its GPALS deployment to participants in the global protection system. For example, we would be prepared to make available processed early warning information from our existing and planned early warning systems for use with ballistic missile interceptors of all types. We would be prepared to cooperate with other participants for coordinated missile defense operations as our capabilities for ballistic missile defense mature. A fundamental element of the GPS concept is that while national forces could be used in support of the GPS, those forces would remain under sovereign national control. The use of such forces in support of a GPS would be governed by agreed "rules of engagement". And finally, we would be prepared to assist through technical cooperation and other activities the development by other participants of the means to defend their own homeland and forces.

The participants in a Global Protection System would establish and operate a Global Protection Center, within which the participants would cooperate on developing and operating a GPS, including efforts to:

- share information on the sources of proliferation and the use being made of proliferated technology,
- share certain specified information on all launches of missiles detected by national sensors, including such information as time of launch, the location of launch, and the direction of flight,

Ballistic Missile Defense Policy

- assist one another to develop their own capabilities for warning and defense against limited ballistic missile attacks, and
- undertake planning activities, engage in exercises and develop models to support cooperative defensive operations against ballistic missile attacks.

The Global Protection Center could be a forum in which individual states could develop military plans to execute cooperative agreements by which the assets of one nation might be used to defend the territory of another against limited ballistic missile attacks. At the same time the participants would retain control of the national assets they had committed to the support of a Global Protection System.

1.4.5 The Missile Defense Act

In the two years since the U.S. shifted the focus of its ballistic missile defense goals to provide protection against limited strikes, the Administration and Congress have moved toward a consensus on fundamental missile defense goals. The Missile Defense Act of 1991, which was part of the FY 1992 Defense Authorization Act, established two basic missile defense goals that were reaffirmed in the FY 1993 Defense Authorization Act:

- (1) deploy an anti-ballistic missile system that is capable of providing a highly effective defense of the United States against limited attacks of ballistic missiles; and
- (2) provide highly effective theater missile defenses to forward-deployed and expeditionary elements of the Armed Forces of the United States and to friends and allies of the United States.

The MDA stated that the limited deployment of defenses should be "designed to protect the United States against limited ballistic missile threats, including accidental or unauthorized launches or Third World attacks." Congress and the Administration continue to agree on the need for a defensive capability to protect against these threats.

The MDA directed the Administration to take several measures to implement the Act's goal of a highly effective defense against limited ballistic missile strikes. The Department is moving forward on each of these. The Department laid out its acquisition strategy towards this goal in its Plan For Deployment of Theater and National Ballistic Missile Defenses forwarded to Congress in June 1992. In the Conference Report accompanying the FY 1993 Defense Authorization Act, the Conferees stated they "believe[d] that the baseline programs for TMD and the limited defense system (LDS) as set forth in this report constitute a low-to-moderate technical risk and low-to-moderate concurrency program as directed..."

The Administration and Congress share the determination to provide, as soon as feasible, protection against limited ballistic missile attack. It remains for the Administration and Congress to agree on the appropriate combination of forces, and for the Congress to provide the funding

needed to achieve this common objective. The Congress has endorsed developing space-based sensors for deployment, but it has mandated that space-based interceptors such as Brilliant Pebbles not be included in the initial plan for the limited defense system architecture described in the MDA. However, it explicitly endorsed robust funding for research and development of promising follow-on technologies, including Brilliant Pebbles. The Department will vigorously pursue the development of space-based sensors for deployment and, as funding permits, continue to develop technologies such as Brilliant Pebbles as a follow-on option to the deployment specified in the MDA as revised in the FY 1993 Defense Authorization Act.

The Conference Report on the FY 1993 National Defense Authorization Act also urged the President to continue to pursue the changes to, and clarification's of, the ABM Treaty that were recommended in the Missile Defense Act of 1991. As discussed above, the United States is continuing its dialogue with Russia on obtaining relief from the current ABM Treaty regime in order to pursue the missile defense goals stated in the MDA and a Global Protection System.

1.5 Theater Missile Defense Initiative

The FY 1993 Defense Authorization Act directed the Secretary of Defense to establish a Theater Missile Defense Initiative (TMDI) office within the Department of Defense (DoD) to carry out all activities in the Department which involve active defense against theater and tactical ballistic missiles. The Secretary of Defense has assigned the TMDI to SDIO to ensure the benefits of complementary technology development and to preclude duplication of effort. For example, strategic and theater interceptor functions such as guidance, propulsion and target kill can be researched using joint technology base efforts. Over 90 percent of the SDIO TMDI system builds on previous SDI initiatives. The efficiencies of closely coordinated theater and strategic defense technology development programs is gained through SDIO management. Additionally, SDIO management will serve to involve all the military services and war fighting Commander in Chiefs (CINCS) in the process of developing missile defenses and assure their efforts are integrated into a coherent, cost-effective program that produces a truly joint service missile defense system.

In accordance with a Memorandum of Agreement between SDIO and the Services in the spring of 1992, a new SDIO acquisition structure has been established under a GPALS General Manager (GM). Reporting to the GM is the Assistant General Manager for Theater Defense, who has been designated as the DoD office to execute the Theater Missile Defense Initiative (TMDI).

As per the FY 1993 Defense Authorization Act, a separate TMD Initiative Report will be forwarded to Congress. To the extent that SDIO programs and activities contribute to the TMDI mission, they will be discussed in this report. Discussion of our TMDI master plan, which includes TMD doctrine and acquisition strategy, is reserved for our TMDI Report To Congress.

1.6 Deployment Planning

The Department has planned, programmed, and budgeted its resources to support the goals of the MDA and established military requirements. With regard to military requirements, the Joint Requirements Oversight Council (JROC) recently validated key performance parameters for bal-

Ballistic Missile Defense Policy

listic missile defense systems which are necessary to protect the United States against limited ballistic missile attacks. At this time, the JROC also reaffirmed the requirement for wide-area theater missile defense against the most capable theater ballistic missile threats.

In response to Congressional direction, DoD is developing for deployment a defensive system located at an initial site. In our negotiations with the Russians, we are seeking relief from the restrictions on the location and number of U.S. ABM sites, including the number of interceptors in the United States, as well as the prohibition on the deployment of space-based ABM sensors. In this eventuality, the site at Grand Forks would be redundant. However, without appropriate updates to the ABM Treaty, the single site it permits would remain at Grand Forks. Because the capability provided by this single site is constrained by the ABM Treaty, it cannot defend the United States against the full range of threats to the required level of effectiveness. In addition, several Treaty issues have not yet been resolved. The capability of this Treaty-limited deployment would be restricted to intercepting a few tens of reentry vehicles (RVs) launched by Intercontinental Ballistic Missiles (ICBMs) or long-range Submarine Launched Ballistic Missiles (SLBMs) aimed at the center of the nation and would be much less effective against RVs aimed at the periphery of the U.S. and not effective at all against those heading for Alaska or Hawaii. Additional sites, prohibited by the ABM Treaty, are needed to provide the required level of defense for the entire U.S. against the full range of threats.

After ABM Treaty compliance issues are resolved, we can undertake, if appropriate, and after consultation with our allies who would be affected, improvements to existing early warning sensors to bridge the gap until the space-based Brilliant Eyes sensors become operational.

1.7 Summary And Conclusions

Two years ago, in response to the dramatic changes in the international security environment, the objective of the Strategic Defense Initiative was refocused to provide protection against limited ballistic missile strikes -- whatever their source. The plan proposed in this Report to Congress represents the Department's effort for achieving U.S. national ballistic missile defense goals, given the budgetary constraints imposed by the Congress.

As stated in last year's Report to Congress, the passage of the Missile Defense Act represented a major step toward a consensus between the Administration and Congress on U.S. ballistic missile defense goals. The national goal identified in the MDA is to deploy a ballistic missile defense system, consistent with stability, that is capable of providing a highly effective defense of the United States against limited ballistic missile attack, and provide highly effective theater ballistic missile defenses for U.S. forward-deployed and expeditionary forces, allies and friends. This goal, and our acquisition strategy, was reaffirmed in the FY 1993 Defense Authorization Act. While there is a consensus on our broad missile defense goals, the challenge we face is achieving the funding levels from the Congress required to achieve those goals.

Finally, last year we saw a significant break from past Soviet policy on ballistic missile defenses that opened a historic opportunity for cooperation in this area. We continue to work with our allies, Russia, and other countries toward the goal of creating a Global Protection System. The elements being developed under the TMDI and SDI programs will comprise the U.S. contribution

to this system. Such a cooperative undertaking holds the promise of enhancing U.S. security, as well as that of our Allies, Russia and other states.

Chapter 2

Strategy And Objectives

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Chapter 2

Strategy And Objectives

This chapter responds to subparagraph (b)(1) of Section 224 of the National Defense Authorization Act for 1990 and 1991 (Public Law 101-189), which requests "A statement of the basic strategy for research and development being pursued by the Department of Defense under the Strategic Defense Initiative (SDI), including the relative priority being given, respectively, to the deployment of near-term deployment options and research on longer-term technological approaches." and to subparagraph (b)(3) which requests "A clear definition of the objectives of each planned deployment phase of the Strategic Defense Initiative or defense against ballistic missiles."

2.1 Introduction

The Missile Defense Act of 1991 (MDA), contained in the FY 1992 Defense Authorization Act, was a major milestone in establishing a consensus between the Administration and Congress on the necessity for ballistic missile defenses for the United States, U.S. forces deployed worldwide, and its allies as soon as technologically feasible. While the MDA focused on a single, ABM Treaty-compliant site for national defense, it acknowledged the need to be able to provide effective protection for the entire U.S. and called for the President to pursue discussions regarding ABM Treaty amendments to permit additional sites. A defense consisting of multiple sites in the U.S. and ground- and space-based elements is necessary to achieve this goal.

These multi-layered defensive systems are funded in the different SDIO Program Elements: Limited Defense System (ground-based weapons and ground- and space-based sensors); Space-Based Interceptors which could be added to the Limited Defense System to make it more effective; Other Follow-on (technologies for improved defense capabilities); and Research and Support activities. Similar concepts of multiple defensive layers are integral to the Theater Missile Defense Initiative (TMDI), which are discussed in a separate report.

To distinguish between TMDI and the Strategic Defense Initiative programs discussed here, the term Strategic Defense will be used to denote those programs directed toward defense of United States territory.

On July 2, 1992, the Secretary of Defense sent to Congress his plan to implement the MDA, indicating that he had directed the Department to execute that plan as a top national priority. The Department's event-driven acquisition strategy accommodated Congressional direction to field defensive capabilities in the mid-1990's with the concerns it expressed about limiting concurrency and risk by remaining close to a core standard defense acquisition model. The core acquisition strategy for national missile defense (NMD) described in this plan provides for deployment of production hardware beginning in FY 2002; options are also provided for fielding an NMD User Operational Evaluation System (UOES) using demonstration and validation hardware as early as FY 1997.

As indicated in Secretary Cheney's July 2, 1992 transmittal letter accompanying this plan, the Secretary's Defense Planning Guidance (DPG) backs up that commitment with instructions that these programs be carried out as a top national priority, consistent with prudent management of cost, schedule, performance, and technical risk factors.

This chapter addresses the impact of the 1993 Defense Authorization and Appropriations bills and conference committee reports on the Strategic Defense Initiative. The discussion of the impact on TMDI is included in a separate document based upon Congressional guidance to separate the two initiatives. In keeping with Congressional guidance, there are a number of programs that support both the defense of the U.S. and TMDI, including the Ground Based Radar (GBR), Brilliant Eyes (BE), System Engineering and Integration (SE&I), Battle Management, Command, Control and Communications (BM/C3) and System Test and Evaluation.¹ In addition to offering cost reductions through dealing with common problems, these joint programs maintain the concept of defense layering to achieve the very highest levels of protection possible.

2.1.1

Revisions to the Missile Defense Act

In actions associated with the FY 1993 Defense Authorization and Appropriation Acts, Congress supported the Department's missile defense acquisition strategy (presented in the July 2, 1992 Report To Congress) which, if appropriately funded, would provide an initial deployment of production hardware as early as the year 2002 and could be categorized as a low-to-moderate risk program. While approving planning for fielding the UOES option as early as the end of FY 1997 to provide a contingency defense with test-proven dem/val hardware, Congress did not approve spending funds for fabrication and fielding of UOES hardware -- but noted no such funding would be needed before at least 1995. The FY 1993 Defense Authorization Conference Report did, however, endorse the department's plans to field a THAAD UOES by 1996. Congress also removed the 1996 target date for fielding the initial site defense system in the U.S. that was the driver for obtaining OSD approval for accelerated contracting actions.²

With regard to both the Space-Based Interceptor layer and the next generation technologies to increase strategic defense effectiveness, Congress, in fact, directed the removal of technology

¹The FY 1993 Defense Authorization Conferees indicated that while they intended that the TMDI be separate from SDI, they also directed that "TMDI and SDI programs, projects, and activities that share common technologies or requirements be closely coordinated, including the use of combined or joint funding and management where appropriate. This direction is designed to ensure the avoidance of redundancy to obtain both technological and financial efficiencies, and to maximize the incorporation of common technologies in specific theater and strategic missile defense systems."

²The requirement stated in the FY 1992 Defense Authorization Act to develop for deployment a treaty compliant initial site "by the earliest date allowed by the availability of the appropriate technology or by FY 1996" was deleted by the FY 1993 Defense Authorization Act. In the FY 1993 Defense Authorization Conference Report, the conferees stated that the development program should be structured with the objective of deploying "by the earliest data allowed by the availability of the appropriate technology and the completion of adequate integrated testing of all system components." They further stated that the program should be conducted "consistent with sound acquisition procedures and in accordance with a low-to-moderate technical risk and low-to-moderate concurrency program."

The Defense Authorization conferees identified the Secretary's July 2 Plan as being such an acceptable low-to-moderate risk / concurrency plan.

programs from SDIO that had weapon applications beyond 10 to 15 years unless the Secretary of Defense determines and certifies that transfer of a particular far-term follow-on technology currently under the SDIO would not be in the national security interests of the United States.

More important than the changes in language were the resulting budget reductions. A summary of the actions on the FY 1993 budget is given in Figure 2-1. The \$5.425B overall budget request, which contained \$4.365B for implementation of the strategic defense portion of the MDA, was provided in the July 1992 Report to Congress, which updated the President's budget request submitted to Congress in January 1992. As shown in the Figure, this budget contained about \$2.4B for the Limited Defense System, \$0.6B for Space-Based Interceptors, \$0.6B for Other Follow-on Technology, and \$0.8B for Research and Support. It was noted in the July report that a substantial majority of the Research and Support line directly supported the LDS acquisition program with targets, test and evaluation support, data centers, and government staff personnel costs.

Figure 2-1. FY 93 Strategic Defense Budget History¹

RDT&E / MILCON (\$s In Millions)			
	180 Day Report² (July 1992)	Authorized	SDIO Apportionment³
Limited Defense System	2,397	2,045	1,699
Space Based Interceptors	576	300	270
Other Follow-on	637	300	309
Research And Support	755	400	424
Total	\$4,365	\$3,045	\$2,702

¹ Does Not Include TMDI Funding

² Provided In July 1992 180-day SDIO Report To Congress: *Plan For Deployment Of Theater And National Ballistic Missile Defenses* Which Updated The President's Budget Request Submitted To Congress In January 1992

³ SDIO Apportionment After Accommodating An Additional \$250M Cut By The Defense Appropriations Conference, Which Funded Both Strategic Defense And TMDI At \$3.805B

The Defense Authorization Conference reduced funding for strategic defense by approximately \$1.3B, \$350 million of which came from the LDS line. In fact, the cut to activities that support the LDS was in excess of \$700 million because essential programs in support of LDS carried in the Research and Support line had to be moved to the LDS line and accommodated within the

Strategy And Objectives

reduced funding authority there. The "SDIO Apportionment" column in Figure 2-1 represents the current allocation of funds against the strategic defense activities, further reduced as a result of reprogramming within the Director's 10% authority and accommodating the additional \$250M cut by the Defense Appropriations conference, which funded both strategic defense and TMDI at \$3.8B.

2.1.2 Programmatic Realignment for LDS

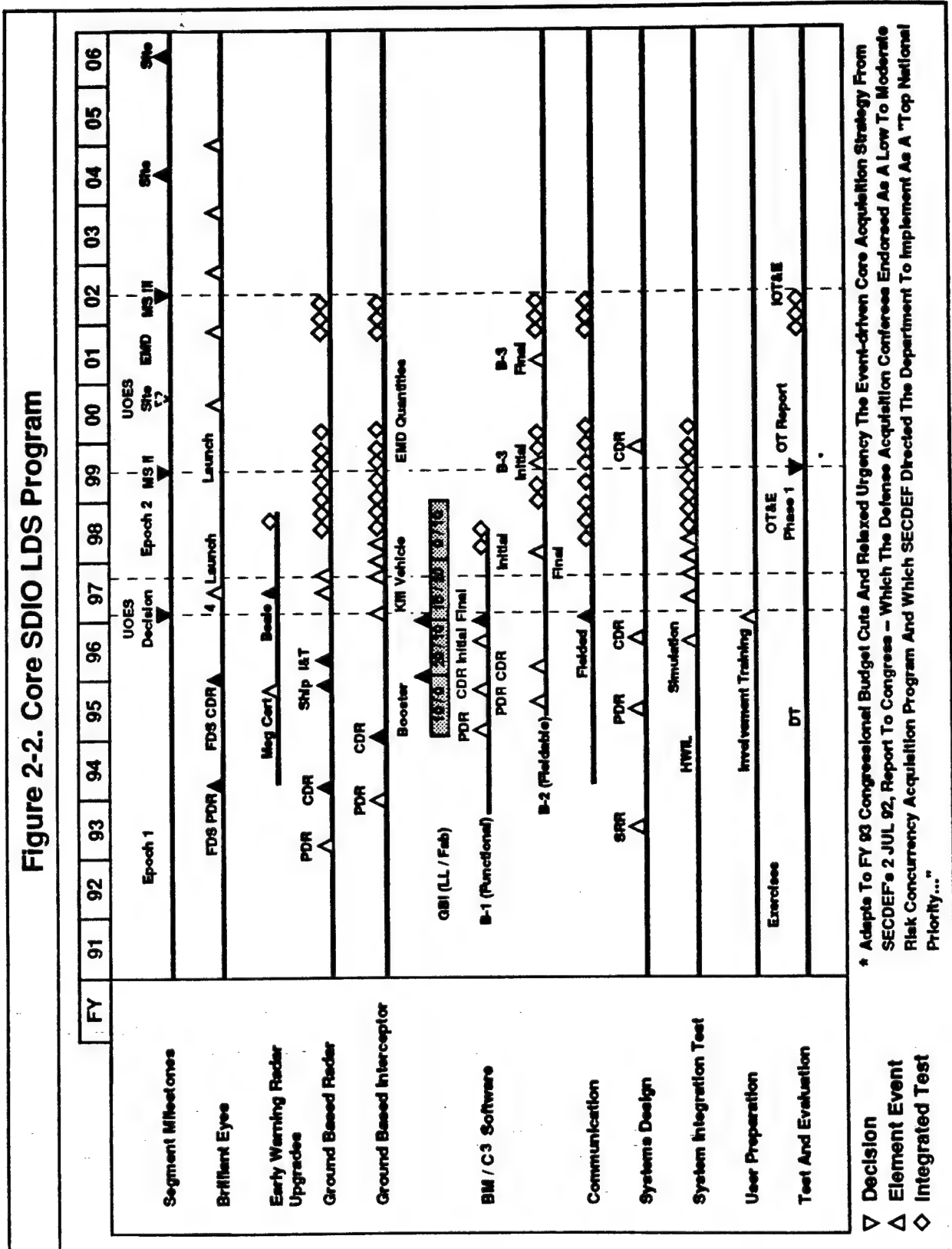
Realignment of those programs directed toward defense of the United States homeland involved some very difficult management and technical decisions. The overall Congressional language gave first priority to TMDI and the Department has emphasized the TMDI programs accordingly, maximizing the FY 1993 funding within the reallocation authority permitted by the Defense Authorization Act. However, to accommodate the \$1.6 billion of FY 1993 budget cuts the date for the initial site had to be slipped.

The removal of the 1996 target date negated the requirement that would justify a sole source contract to continue the present System Engineering and Integration (SEIC) contractor. Reduced funding and the recompetition effort contribute to an up to 18 month delay from the acquisition plan in the July 2 Report to Congress. Thus, the allocation of FY 1993 funds and the programming of outyear funding requirements sought to hold the schedule slip to 18 months.

The new schedule for the core baseline program, shown in Figure 2-2, would provide hardware for the initial, ABM Treaty-compliant, anti-ballistic missile defense site in FY 2004 -- some 18 months later than could have occurred in the Department's 2 July acquisition plan in the absence of executing any of the three UOES contingency fielding options. In response to Congressional directions that fabrication and fielding costs for a UOES option were not authorized at this time, we have budgeted only for planning to provide such an option -- as explicitly permitted by the Authorization Conferees. Should the Congress decide later to exploit such an option, funding would be required in FY 1997 to fabricate and field the initial site in the year 2000 -- some 18 months later than the moderate risk/concurrency option described in the Department's July 2 Report to Congress. Thus, in structuring our response to the FY 1994 - FY 1999 POM guidance from OSD, which preserved the outyear funding stream, we have maintained the core strategy presented in the July 2, 1992 plan, while reprioritizing and rescheduling major elements of the program to take account of Congressional direction and priorities, as well as the substantially reduced FY93 appropriated funding. Maintaining the basic event-driven strategy for the program is essential because that strategy represents an approach on which the Department and Congress agree.

We intend to proceed with the basic element contracts (BE, GBI, and GBR) while competing for a systems integration contractor who, as the lead associate contractor on the team, would be accountable to SDIO for Total System Performance Responsibility (TSPR). In being accountable for TSPR, the contractor would be responsible for overall systems engineering and integration, integrated systems test, the development of the Battle Management, Command, Control, and Communications (BMC³), and site integration. This quasi "prime" contractor status for the BMC³/SE&I contractor is essential for the success of this complex multi-service program. During the 18 month interval before the full contractor team is in place, the management and integration responsibilities to continue the integration activities will rest upon the SDIO/Service management team with support from the current SEIC and support contractors as needed.

Figure 2-2. Core SDIO LDS Program



Strategy And Objectives

2.1.3 Programmatic Realignment of Follow-On Activities

Out-year funding for Space-Based Interceptors (SBI), Other Follow-on (OFO), and Research and Support (R&S) has been substantially reduced to a level of effort reflecting the implicit priorities of the FY 1993 Congressional action. Within SBI, this provides for a Brilliant Pebbles (BP) technology demonstration program which would delay consideration of this concept for inclusion in the future architecture until nearly the end of the decade. OFO and R&S will focus on only the most important long-term technologies supporting advanced capabilities that might be required to respond to future threat evolution. R&S also continues to fund salaries and other support activities.

2.1.4 Overall LDS Program Strategy

SDIO has created a core acquisition strategy to obtain an ABM Treaty-compliant missile defense site as the initial step toward a multi-site Limited Defense System (LDS) as defined in the MDA. This strategy is depicted in Figure 2-2. An option also exists to obtain needed near term contingency capabilities while creating a base to support an evolutionary improvement of capabilities in the mid and far term. Figure 2-3 shows these architecture concepts. Plans are fashioned to meet key management challenges such as acquiring a complex, multiservice system of systems, while coping with geopolitical, technical, and budgetary uncertainties, fully realizing performance goals in the long term.

Part of this strategy is a cooperative management approach between SDIO, the users, and the Services that provides appropriate responsibility and accountability for developing, fielding and operating the various service elements of an integrated, multiservice system of systems. Sustained stable funding is also an essential part of this strategy.

Also, it is extremely important to maintain a sound technology base program to provide options for technology insertion into systems under development, and to create new system elements to improve system effectiveness and/or to mitigate risk during the accelerated fielding of the initial site and to respond as necessary to threat evolution. Risk mitigation is an important result of creating this robust technology base. In addition to providing options for technology insertion, the technology base provides for alternative solutions at component or system level. This is an essential feature to allow rapid system response to threat changes in an uncertain world without the expense of maintaining formal development programs to deal with all contingencies. FY 1993 funding reductions strongly impact the technology program.

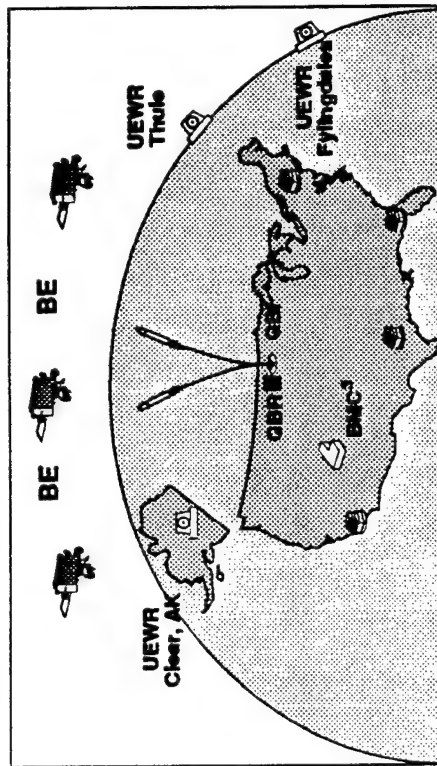
2.2 The Limited Defense System

This section is divided into three subsections that discuss plans for the initial site deployment based on the core acquisition strategy, the UOES contingency option, and deployment of the overall multisite Limited Defense System. Figure 2-4 depicts the schedule for these objectives.

2.2.1 The Initial Site of the Limited Defense System -- Core Program

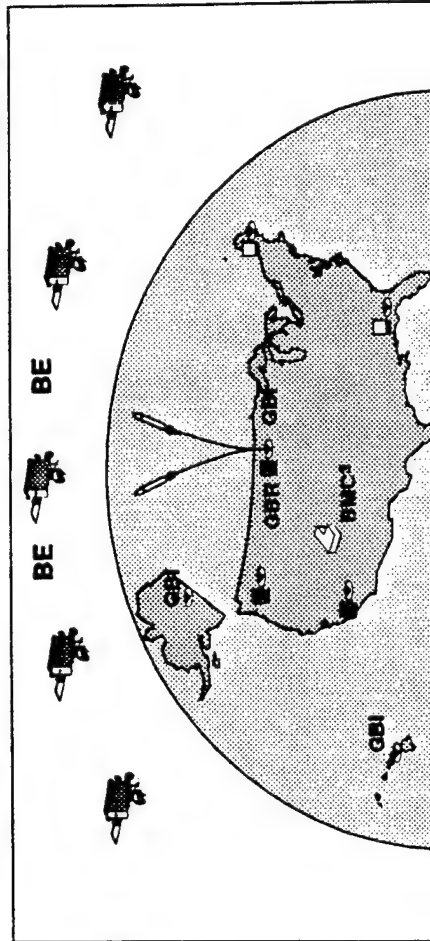
As the initial step toward deployment of a system capable of fulfilling the goals of the MDA and meeting existing military requirements, the Act, as revised in the FY 1993 Defense Authorization

Figure 2-3. Strategic Defense Architecture Concepts



Core Program Initial Site (2004)

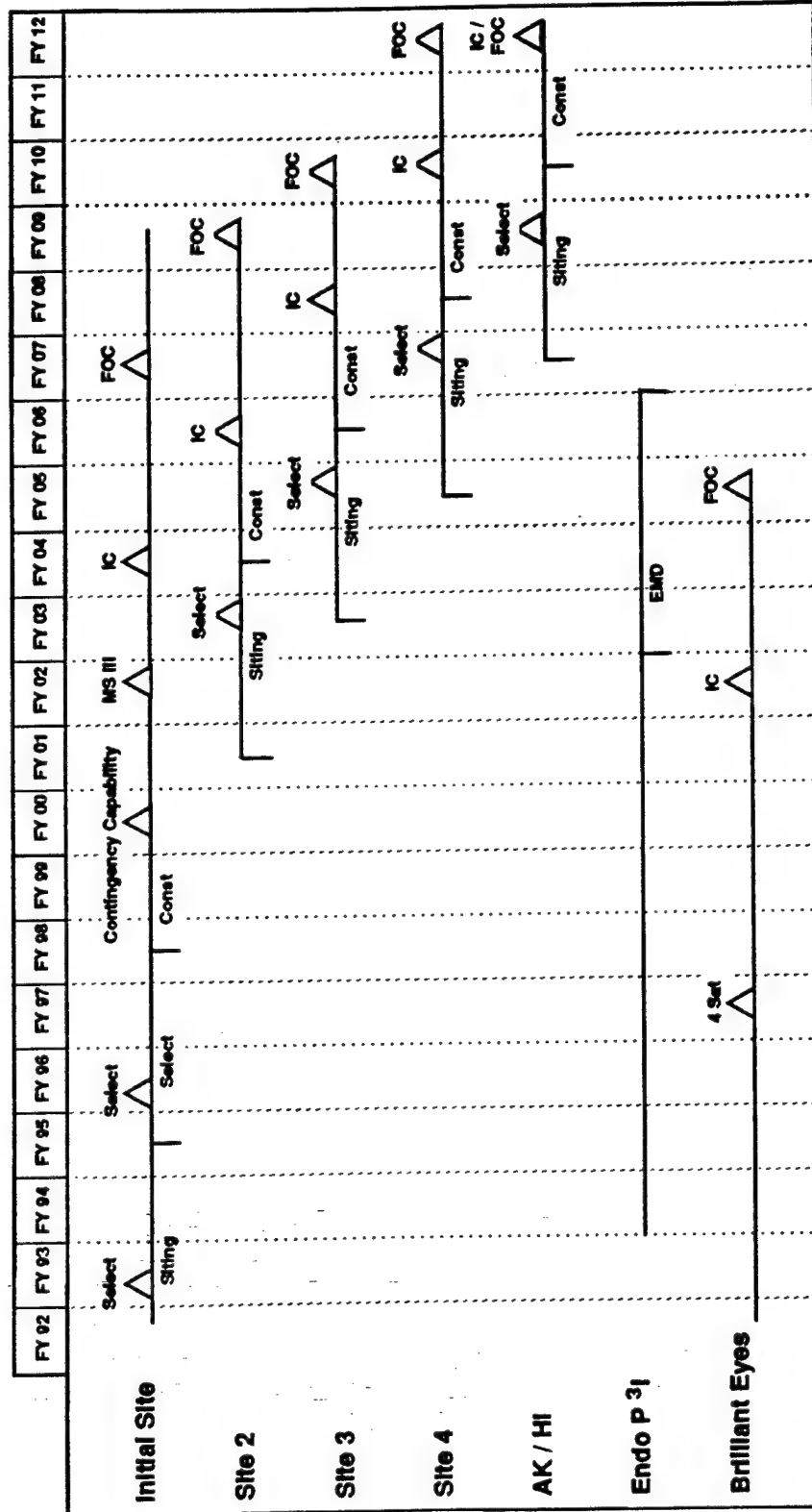
UOES Option For Initial Site (2000)
Decision In FY 97



Multisite Limited Defense System (2006-2012 Appx.)

GBR - Ground Based Radar
 GBI - Ground Based Interceptor
 BMC3 - Battle Management, Command, Control, And Communication
 BE - Brilliant Eyes
 UEWR - Upgraded Early Warning Radar (= BMEWS; = PAVE PAWS)
 UOES - User Operational Evaluation System

Figure 2-4. Limited Defense System Deployment Plan



Note: • All IC and FOC entries are tentative and will be better established through discussions between the user and SDIO
 • Dates are target dates; actual dates will be determined by successful accomplishment of key events

Bill, directed, as a high priority, the Department to "develop for deployment a cost-effective, operationally-effective and ABM Treaty-compliant ABM system at a single site..."(Sec. 234(c)(2)). The Joint Explanatory Statement of the Committee of Conference accompanying the MDA (FY 1992 Defense Authorization Act) acknowledged the requirement to accelerate normal acquisition processes and procedures to meet the priorities of the MDA.

Figure 2-5 depicts the acquisition approach for activating the initial site under the core acquisition strategy. Following Milestone (MS) II in FY 1999, Engineering and Manufacturing Development (EMD) will be used to produce low rate initial production (LRIP) for initial operational test and evaluation (IOT&E) preceeding MS III in 2002. The IOT&E testing is done to demonstrate that LRIP hardware satisfies the operational evaluation criteria that the user, U.S. Space Command, and the Joint Staff, have established for national missile defense. Assuming successful IOT&E results, production approval would be given at MS III. Initial site activation could start 2 years later in 2004.

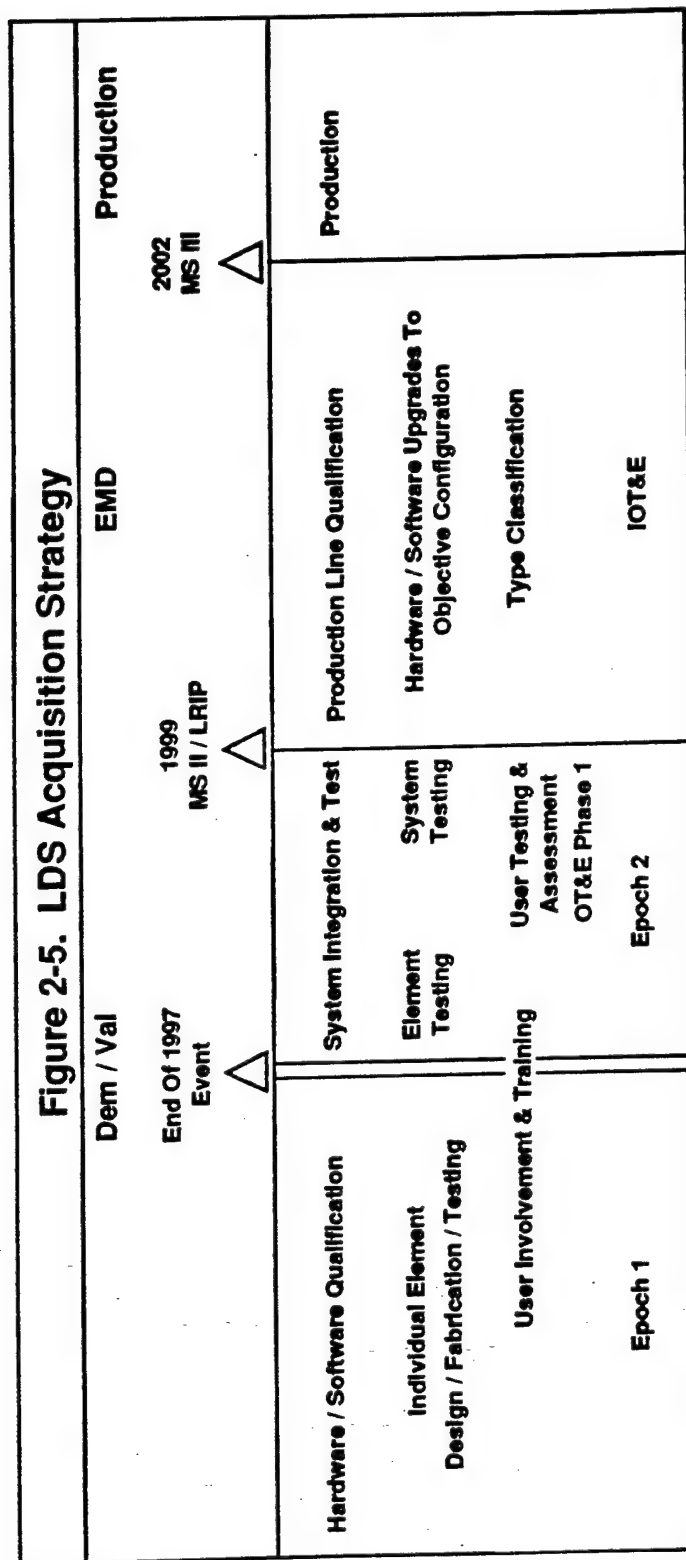
The initial LDS site will be located at Grand Forks, North Dakota, unless the ABM Treaty restraints are relaxed soon enough to permit an alternate first site.³ Selection of another location for the initial site could save at least \$2 billion in the overall costs of deploying the full Limited Defense System, because one less site would be necessary for the full system, which would deploy sites on the coasts. In deciding on the appropriate initial site, consideration also must be given to other factors which could delay fielding activities, such as environmental impact assessments.

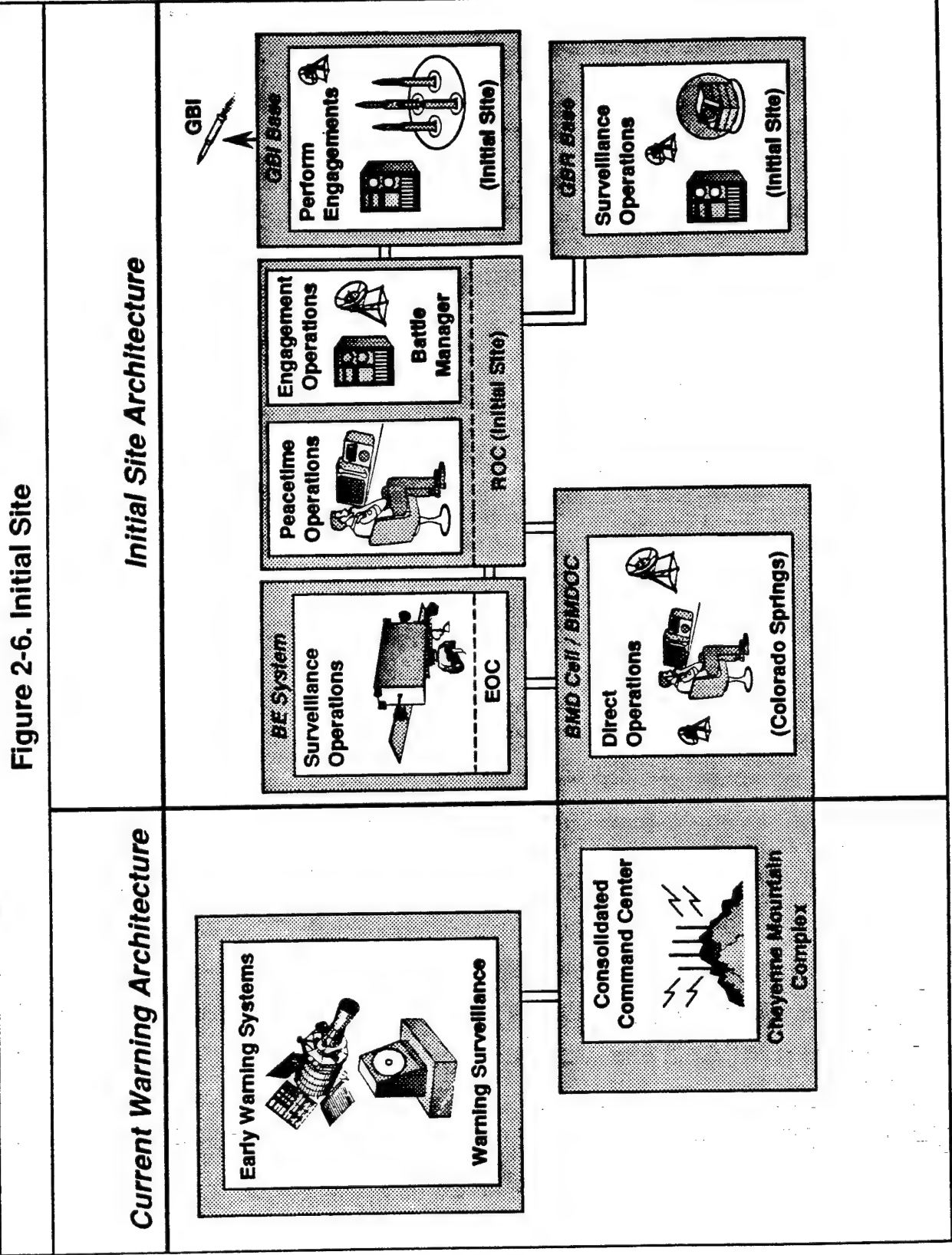
The initial site system (illustrated in Figure 2-6) will consist of a Ground-Based Radar (GBR), up to 100 Ground-Based Interceptors (GBI), and a collocated Regional Operation Center (ROC) containing radar and interceptor operational control facilities and battle management (sometimes referred to as Battle Management, Command, Control and Communications or BMC³). A BMD command and control center in Colorado Springs is planned where command and control operations could be carried out. The level of interfacing and integration with existing and planned C2 systems is under investigation. The Department's current plan supports deployment of Brilliant Eyes space-based sensors beginning in FY 2002. Thus, BE could provide the over-the-horizon sensor capability enabling a single missile defense site in the middle of the continental United States to intercept northerly ballistic missile attacks comprising a few tens of reentry vehicles targeted across the CONUS⁴. The Administration has yet to make a decision regarding BE compliance with the ABM treaty.

The initial site system would function as follows: Early warning sensors would alert the Commander in Chief of the U.S. Space Command (CINCSpace) to a missile launch. After initial

³As directed in the FY 1993 Defense Authorization Conference Report, SDIO will plan the architecture for the initial, treaty-compliant ABM site on the basis of the Treaty as now constituted and not as it may be revised.

⁴The MDA directs the Secretary of Defense to develop for deployment an ABM Treaty-compliant site to include "Optimum utilization of space-based sensors, including sensors capable of cueing ground-based antiballistic missile interceptors and providing initial targeting vectors..." While BE is being considered for inclusion in the initial site architecture, the administration has yet to make a determination on the issue of BE compliance with the ABM Treaty.





tracks are established and it is determined the U.S. is under attack, the defense system would be activated by CINCSpace. The incoming threat would be confirmed and tracked to sufficient accuracy to support the launch of Ground-Based Interceptors (GBI). Depending on the aim points of the incoming reentry vehicles, threat trajectory updates would be provided to the GBIs, based on further track data from Brilliant Eyes or from acquisition and track by the Ground-Based Radar (GBR) at Grand Forks. For those reentry vehicles coming into the coverage zone of the GBR, additional detailed data on the threat complex might be provided to the GBI. In either case, when the GBI approaches within a few hundred kilometers of the threat reentry vehicles, its on-board optical sensors acquire the threat complex, perform further discrimination of the reentry vehicle from other objects in the threat complex, and support the terminal homing of the GBI to intercept the reentry vehicle.

The following is a summary of the status and plans for the individual elements associated with the core acquisition program:

GBI. An options assessment phase was completed, in which three contractor teams investigated approaches to achieve a near term capability and to infuse technology for the longer term. The GBI Request for Proposal has been released. In parallel, the three contractor teams are developing designs and building component hardware under the earlier awarded GBI-X contracts. The earliest GBI contract award would be in May 1993 for the demonstration/validation program including the option for fabrication of UOES missiles for fielding at the first site.⁵ Congressional direction does not authorize fabrication and fielding of UOES missiles, but does permit planning -- and holds open the possibility of approval after 1995.⁶

GBR. The contract for development of the NMD and TMD GBRs was awarded in September 1992; it includes an NMD test radar to be fielded at the Kwajalein Missile Range and an option for fabricating an additional radar for use with the NMD UOES. Consistent with direction provided in the FY 1993 National Defense Authorization Conference Report, though planning will continue, the option for the NMD UOES radar will not be exercised without explicit authorization by the Congress. By having an integrated acquisition strategy for the LDS and TMD-GBR, and a single contractor, SDIO anticipates that the total acquisition costs for the GBR program may be about 20 percent less than would be the case for two distinct radar programs.

Upgraded Early Warning Radars (UEWR). To support the UOES option, SDIO is planning an interim cueing option, should Congress in the future approve fielding of

⁵ABM Treaty issues regarding deployment of GBI also remain for resolution.

⁶The GBI is an exoatmospheric ("outside the atmosphere") interceptor. SDIO is also pursuing an endo ("within the atmosphere") technology program that will allow initiation of a pre-planned product improvement (P3I) to the GBI after the year 2004 to produce missiles with an exo-commit / endo-intercept mode of operation. This option, which was previously associated with the E²I concept, would be exercised if a threat requiring such robust discrimination is observed.

the initial site prior to 2004, that could provide full coverage for the continental United States, including areas beyond the viewing range of the GBR at the initial site. This option involves upgrading the capability of U.S. BMEWS and Pave Paws radars. Initially, the Beale (California) Pave Paws radar may be upgraded to support tracking of targets going into the Kwajalien Missile Test Range. This upgrade will consist primarily of software changes. Appropriate measures to ensure compliance with the ABM Treaty are required before this work starts. Assuming approval, the data obtained during testing would serve as the basis for a potential follow-on decision to upgrade the remaining Early Warning Radars in support of contingency defense options. Decisions to upgrade these radars would be done in consultation with the host governments, as appropriate.

Brilliant Eyes (BE) is the principal means for cueing GBI and, for longer range ballistic missile threats provides a major enhancement of defended area for TMDI interceptors, as well as providing key midcourse discrimination data to enhance the effectiveness of fielded defenses. This cueing data is provided to interceptors through NMD and Theater Missile Defense BM/C³I facilities. The Defense Acquisition Executive (DAE) has approved SDIO's acquisition approach for Brilliant Eyes, and two contractors were selected in December 1992 to pursue the demonstration/validation (dem/val) phase, with a early 1998 down-selection to a single contractor for engineering and manufacturing development (EMD). According to current plans, an initial BE constellation could be in place to support an initial site which becomes operational in 2004.

GSTS. Though the program has been well managed by the Army and has made excellent technical progress, a decision was made to cancel the Ground-based Surveillance and Tracking System program. Evolving mission requirements and acquisition schedules, combined with severe funding cuts by Congress for fiscal year 1993, led SDIO to conclude that an additional \$400 million could not be justified to complete the remaining two-thirds of the current contract.

In our program response to the Missile Defense act of 1991, GSTS was maintained as one of three options for providing the necessary interim over-the-horizon sensor support to provide full early contingency coverage for the continental United States from the initial site -- before Brilliant Eyes could be available. Congress, in acting on the fiscal year 1993 budget, removed its requirement for early contingency defense capability; endorsed only the Department's core U.S. defense acquisition strategy that led to an initial site in 2002; and cut the LDS FY 1993 funding by at least \$700 million leading to a significant schedule slip.

An initial Brilliant Eyes capability can be established by the year 2000 within the currently planned budget -- i.e., two years earlier than the Congressional target date for the initial site. Furthermore, a Brilliant Eyes capability in the year 2000 would be available when a User Operational Evaluation System could be fielded at the initial

site, should Congress agree by FY 1997 that such a step is prudent. Therefore, an interim cueing sensor is not necessary, and an unnecessary element is not affordable, especially given the \$1.6 billion cut from the President's FY 1993 budget request.

BMC³. The command and control architecture for the initial site is the foundation for an open BM/C³ architecture system. Key issues for the initial site activation include interfacing with the Integrated Tactical Warning/Attack Assessment (ITW/AA) system at Cheyenne Mountain and the development and validation of functional software. The functional software code needed to support the initial site is planned to be operating by the end of FY 1996. Full functional capability, including integration with the ITW/AA system at Cheyenne Mountain, is not expected to be completed until around the year 2000 -- but this could support an initial UOES capability, should Congress later decide to appropriate funds for fabricating and fielding the elements for such a site.

CINCSpace will have operational control of the LDS, but most, if not all, of the LDS will be operated and supported by the component commands of USSPACECOM. Military personnel would be used in performing all of the critical command and control functions of the LDS. Personnel training would begin as early as practical, but in sufficient time to have operators trained prior to operational testing. Those personnel trained for testing would become the operator/maintainers of the initial operational LDS site. This strategy is fully coordinated with the Office of the Assistant Secretary of Defense for Command, Control, Communications and Intelligence.

System Engineering and Integration (SE&I). Presently, the development of specifications drawn from the operational requirements provided by the User (USSPACECOM) is supporting the preparation of the Acquisition Program Baseline. This Baseline is currently being coordinated within the DoD. The current SE&I contractor has been developing proposed specifications, standards, and interfaces definitions to insure that all GPALS elements will work together as a system. This contractor will maintain these engineering specifications, baselined during FY 1993, while SDIO conducts an open competition for a BMC³/SE&I contractor during FY 1993-FY 1994. The contract to be awarded will be for the dem/val phase (approximately 5 years) with a follow-on option for the EMD phase (up to 5 years). The BMC³/SE&I competition will transfer the lead of this effort to the winning contractor in late FY 1994.

The winning contractor, responsible for both the development of the BMC³ (hardware and software) and the systems integration, will continue to refine the specifications and integrate all of the elements into a working system, demonstrating its capabilities at increasing levels of maturity for dem/val Milestone II and EMD Milestone III.

System Testing. The system test program has been developed to reduce risk through a comprehensive series of simulations, integration exercises, element demonstrations,

system integration tests, and full system emulation. These efforts are conducted at the National Test Facility (NTF), the centralized controlling and computing element of the SDIO National Test Bed (NTB). Element and segment simulations and emulations and integration testing conducted at the NTF and other NTB technical centers will enable the SDIO to establish system-level confidence in defensive systems while reducing redundant development and start-up costs.

Technology and element tests conducted to date have provided a strong foundation from which to proceed. These tests will be expanded upon to continue a logical progression of test and evaluation to assess system critical technical performance parameters and critical operational issues, as well as verify system simulations.

Initially this will be accomplished by combining a series of planned target development flights and functional element surrogates with the early BMC³ development builds to conduct a series of system integration exercises (IE). Each succeeding Live-Flight Integration Exercise (LFIE) improves confidence and knowledge and lowers the risk for testing the dem/val prototype configurations involving GBI, GBR, and BMC³. A tactically representative site will be built at Kwajalein to support this developmental testing program as well as future operational testing. Element testing will be followed by full System Integration Tests (SIT). The data from component, element, and system tests will be used to validate a real time hardware in the loop system emulation which will be used to extrapolate to full system level performance with appropriate nuclear environments. In the core program Initial Operational Tests and Evaluation would occur prior to MS III. If the UOES option is exercised an OT&E Phase I would be conducted prior to UOES fielding. This strategy is fully coordinated with the OSD test and evaluation community.

Site Integration. Planning is underway to ensure that the construction, hardware and software installation, and test efforts result in the successful delivery of the initial defense site with documented evidence of system safety, performance, interoperability, and readiness for the Services to utilize in support of USSPACECOM. This is an important effort in terms of schedule and resources required.

Timely and well thought-out site integration plans will be critical to meeting the initial fielding date.⁷ SDIO will take advantage of lessons learned from site activation associated with earlier military systems. It is envisioned that the U.S. Army Corps of Engineers would be responsible for the physical plant aspects of the site activation process to include refurbishment and new construction, whether it is accomplished organically or by the use of contractors. Site construction would take approximately

⁷The overall Programmatic EIS process was begun in the Fall of 1991 and a Notice of Intent (NOI) was published in the Federal Register on February 4, 1992. Public scoping meetings were held in Washington, DC, and Los Angeles, CA, in late February 1992. The programmatic EIS will describe the broad programmatic environmental consequences associated with Ballistic Missile Defense life cycle, including generic basing and siting issues within potential deployment regions.

two years (though winter conditions at Grand Forks likely constitute the "worst case" construction scenario).

Initial site integration would be accomplished by a site activation team comprised of the military user services, Corps of Engineers, SDIO, the LDS Prime Contractor, and the Associate contractors. Use of existing launch and support facilities would be considered with upgrade, modification, and interface requirements included as part of the initial configuration activity for Site 1. All of the site activation decisions occur after full flight and system testing at USAKA.

2.2.2 The UOES Option

As explained above, consistent with Congressional guidance, SDIO is planning to provide a low-to-moderate risk/concurrency option which, if approved and funded by Congress, would permit the fabrication and fielding of a UOES at the initial site as early as in the year 2000. Pending an assessment of progress in the Department's acquisition plans, and the evolving threat, the Administration may propose after 1995 exercising such an option beginning in FY 1997. No additional funds prior to FY 1997 are required to plan for this option; it is a by-product of the core acquisition strategy presented in the Department's July 2 report to Congress, which was subsequently endorsed by the FY 1993 Defense Authorization Conference Report as being a low-to-moderate risk/concurrency program as required by amendments to the Missile Defense Act of 1991.

It should be understood that the Department's ability to effectively manage the various risk factors involved in this program plan will be strongly dependent upon a stable management and funding plan and the continuing support of the Congress for the plan. The risks attendant with concurrency would be exacerbated if stable future funding is not provided. With that qualification, the Department's plan will allow the time necessary to develop and produce the hardware and software necessary to integrate, test and field, in the year 2000, a contingency capability to protect the continental U.S. against a limited number of reentry vehicles delivered by one to a few ballistic missiles headed toward the U.S. from northerly directions.

This UOES capability would grow and improve in an evolutionary fashion, under continued testing and evaluation and subsequent technology upgrades as an engineering and manufacturing development phase firms up the design for subsequent sites. Involving the user from the outset of the dem/val phase would contribute to assuring that the final system configuration meets the user's needs.

2.2.3 Cost of the Initial Site

The total acquisition program for the ground-based elements of the initial site, including necessary risk mitigation and technology insertion activities, is expected to cost \$22-24 billion in constant FY 1991 dollars — whether or not the UOES option is executed. It is anticipated that the total acquisition cost of BE will be \$4-5 billion. Thus, the total cost for a single site system to defend against northerly threats is expected to be \$26-29 billion. Independent cost estimates will not be available until later this summer.

In testimony to the Senate Armed Services R&D subcommittee on May 20, 1992, the SDIO Director indicated that the ground-based elements of the initial site would cost \$16-18 billion. Two-thirds of the \$6 billion increase noted above results from increases in the cost estimates of the ground-based interceptor (based on independent cost estimates provided by the DoD Cost Analysis Improvement Group (CAIG)) and one-third is associated with the 18 month program stretchout in response to Congressional action on the FY 1993 budget.

2.2.4 Completing the Limited Defense System

The LDS architecture for the defense of the United States as set forth in the MDA ultimately would include multiple ground-based interceptor sites supported by both ground-based radars and space-based electro-optical sensors. The number of ground-based interceptor sites required is driven by the nature of the threat assumptions and by whether the initial site is in North Dakota or the Northeast or Northwest. The required number of sites to provide defense coverage against the full range of limited ballistic missile threats ranges from three to five in the continental United States (CONUS) depending on assumptions about the threat and whether the initial site is at Grand Forks, plus one each in Alaska and Hawaii -- i.e., from five to seven total. SDIO is presently planning for four sites in CONUS plus Alaska and Hawaii.

If the core acquisition program is followed, the second site would follow two years after the initial site is activated in FY 2004. If the UOES option is pursued, this schedule could be advanced.

The additional sites will all contain ground-based interceptors and a ground-based radar, except for Alaska and Hawaii. These latter two sites may not need ground-based radars, since BE should be sufficient to handle a smaller expected threat. A decision to upgrade the GBIs to include an endoatmospheric intercept capability or an advanced exoatmospheric discrimination capability could, with the necessary funding, lead to such upgrades by the middle of the next decade, but a deployment decision would be based on the evolving threat.

According to SDIO estimates, acquiring six LDS sites and Brilliant Eyes is expected to raise the total cost of the LDS to something on the order of \$37 billion (in FY1991 dollars), including the associated technology work. This is a preliminary estimate, and more refined cost estimates will be available later this summer. Figure 2-7 depicts the LDS funding profile.

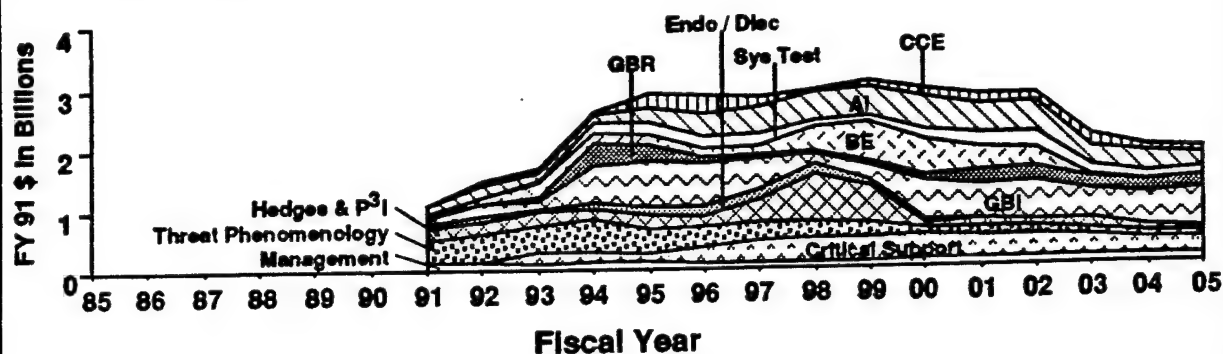
2.3 Technology Development Supporting LDS

The SDIO LDS technology program supports the LDS deployment schedule with technologies needed by identified SDIO elements and with technology that would be used to improve upon the capabilities of elements as in a pre-planned product improvement (P3I) program as a block upgrade. Funding reductions have greatly reduced the content of these technology programs.

2.3.1 Near Term Activities

The near-term objective of the Technology program is to complete the development, and to demonstrate technology readiness, for the focal planes, processors, communications, power subsystems, propulsion systems, and other technologies required for the initial GPALS elements

Figure 2-7. Limited Defense System



GBR - Ground Based Radar
AI - Architecture Integration
CCE - Command And Control Element
GBI - Ground Based Interceptor
BE - Brilliant Eyes
Endo / Disc - Endoatmospheric / Discriminating Interceptor
P3I - Preplanned Product Improvement

including GBI, GBR, and Brilliant Eyes. For example, these efforts include:

- a balanced program to develop and demonstrate infrared sensor component technology required for the performance, reliability, producibility, and affordability of GPALS surveillance and interceptor systems including infrared detectors and read outs, cryocooler development and life testing, radiation-hardened mirrors and coatings and optical test facilities.
- The development of microwave radar components required for tactical and strategic ground-based radars such as solid state transmit/receive modules and wideband signal processors for endo/exo-discrimination.
- The signal processing project develops and demonstrates the components and techniques required by the sensor/interceptor for onboard, high-speed signal and data processing such as radiation-hardened digital and memory components, advanced signal/data processing architectures, and technology demonstrations of radiation-hardened processor systems (ASCM).
- The discrimination program provides for analysis and simulation in the support of TMD and NMD discrimination including the characterization of radar and optical signatures of threat objects (reentry vehicles and penaids), analysis and modeling of

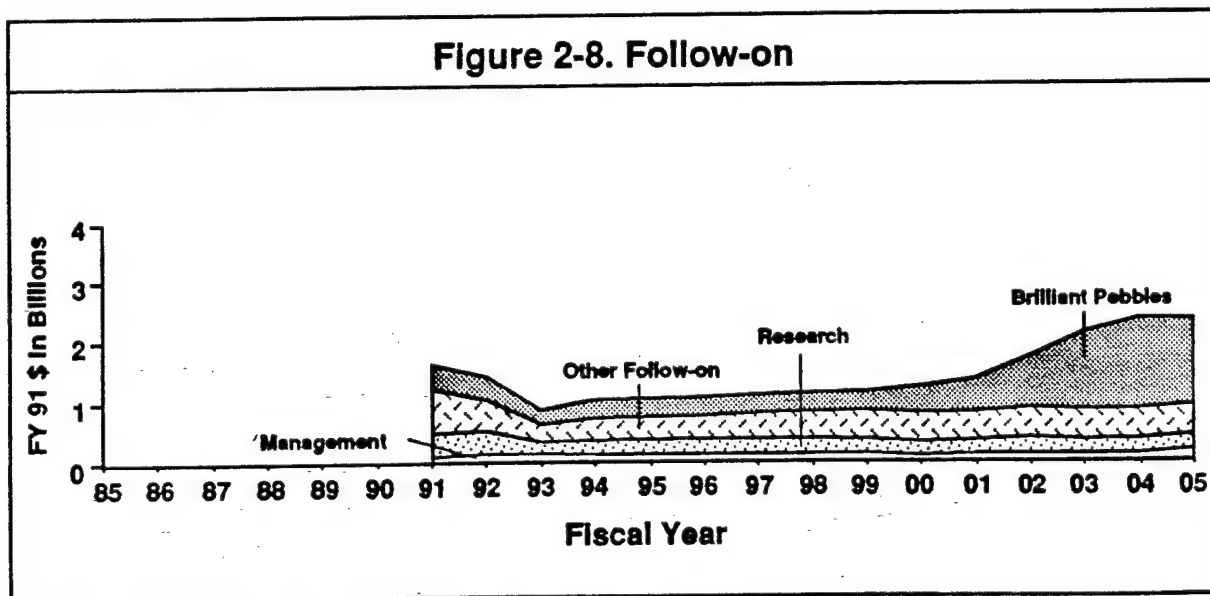
atmospheric and celestial backgrounds, validation of radar and optical discrimination algorithms, and integrated tools and realistic assessment of surveillance, acquisition, tracking and discrimination techniques.

- Advanced technology demonstrations of the above sensor technologies to integrate and assess these sensor technologies in as realistic an operational environment as possible. The MSX and SPAS III experiments will provide system functional demonstration, target and background data. These experiments will provide data on real targets against real backgrounds at realistic system ranges; high-quality target and background phenomenology data (boost phase through deployment of targets) for development of realistic models of representative scenes; demonstrate key functions of acquisition, tracking, handoff and bulk filtering; provide multi-wavelength target signature data for evaluating optical discrimination algorithms; and demonstrate the ability to integrate key sensor technologies into a working platform similar to proposed operational Brilliant Eyes midcourse sensor designs.

These demonstrations of sensor and interceptor technology, coupled with advanced simulation technologies, will lead to comprehensive assessments of the technology feasibility, affordability, and operational utility of GPALS sensor and interceptor systems.

2.3.2 Follow-On Activities

Follow-On activities incorporate those programs associated with the Space-Based Interceptor, Other Follow-on and Research and Support Program Elements. Figure 2-8 depicts the out-year funding profile for these Follow-on programs.



Space-based Interceptors

Strategy And Objectives

The MDA as revised in the FY 1993 Defense Authorization Act directs that space-based interceptors such as Brilliant Pebbles not be included in the initial plan for deploying the Limited Defense System. The Defense Authorization Act does maintain a separate space-based interceptor Program Element, including Brilliant Pebbles (BP), which has as its primary objective, "the conduct of research on space-based kinetic kill interceptors and associated sensors that could provide an overlay to ground-based anti-ballistic missile interceptors." (Sec. 236(b)) Furthermore, the MDA explicitly stated a requirement for "robust funding" for research and development of such promising follow-on ABM technologies (Sec. 234(a)).

In response to congressional direction, SDIO, with approval of the USD(A), is reorienting the program from an acquisition program aimed at deployment with the rest of the architecture to an extended demonstration/validation program with a decision on whether to move toward deployment to be made around the end of the decade. The objective of this effort is to continue to develop and demonstrate a space-based interceptor concept with the capability of satisfying user operational requirements. Program management has been transferred from SDIO to the Air Force. As an Air Force program, BP will continue with two contractor teams aimed at validating the viability, producibility, and operations concept of BP as a future military capability.⁸

A future space-based interceptor would provide the United States with the means to destroy an attacking missile during boost, post-boost, and early mid-course phases of flight. A space-based layer as an overlay to ground-based defenses would significantly improve our ability to meet protection effectiveness objectives. Moreover, space-based interceptors also would provide a global, world-wide capability for protecting U.S. forces deployed abroad, and our friends and allies, against missiles with ranges beyond about 500 kilometers.⁹

The FY 1993 Defense Authorization Act specified \$300 million as the funding ceiling for a space-based interceptor technology demonstration. The Director, SDIO in exercising his reallocation authority, reduced BP funding to \$270 million -- transferring \$30 million to TMDI programs. The investment of the next five years in space-based interceptor technology, is relatively constant and is relatively small when compared to the investments in the Limited Defense System and Theater Missile Defenses, which grow significantly over the next several years.

Other Follow-On Technology

In the long term, SDIO seeks to develop the technologies that lay the foundation for defensive systems that provide significant added performance capabilities for countering potential future threats which may well increase in both number and sophistication. Most of these far-term technologies are funded under the Other Follow-On program element. The Other Follow-On program element supports two categories of activities.

The first category is directed energy systems. Directed energy systems could provide an important capability in the new geopolitical environment as well as provide options for new missions.

⁸The SDIO estimate of the acquisition cost for a 1,000 BP constellation is \$9.9 billion in FY 1988 constant dollars.

⁹For further details, see the Secretary's March 1992 Report To Congress on Conceptual and Burden Sharing Issues Related To Space-based Ballistic Missile Defense Interceptors.

One of the most stressing threats to be faced in the years ahead is the addition of chemical and biological submunitions to theater missiles. The most effective way to negate these is to stop the attacking missile before these munitions can be deployed. Because of the short burn time of most shorter range theater ballistic missiles, conventional space-based kinetic interceptors cannot get to the booster before it leaves the atmosphere. But space or aircraft-based lasers, which can deliver lethal energy at the speed of light, can get to the booster. Other directed energy approaches, such as the neutral particle beam (NPB), have applications to strategic defense even at lower power levels. At lower-than-weapon power levels, neutral particle beams could provide the capability to discriminate, perhaps non-destructively, warheads from other materials such as decoys or debris.

The second Other Follow-on category is for other advanced technologies, and includes very advanced interceptors, sensors, materials, and power technologies. This includes hypervelocity gun projectiles, unconventional launch approaches, small satellite technology and advanced power programs. These could provide technologies for new elements to lower costs or to improve performance or robustness, or to address new threats as they emerge. Another important factor to be considered is the transfer of critical technology to other military applications and systems. Numerous technologies developed under SDIO management have helped improve conventional weapon systems and helped reduce development or production costs.

Finally, SDIO maintains an aggressive Innovative Science and Technology (IS&T) and Small Business Innovative Research program (SBIR). \$127 million is being invested in FY 1993 in IS&T and SBIR in the Research and Support Program Element. SDIO receives tremendous leverage from this type of research. A small investment by SDIO frequently encourages additional Service, state or university investment. SDIO supports 700 innovative research and SBIR programs at about 100 universities and 150 small business in 44 different states. The average contract in these areas is for \$200,000 and supports about 4 to 5 people.

All too often, technology invented in America is first incorporated into new products in Japan and elsewhere. For this reason, SDIO has established what many believe is the best technology transfer program in government. In this regard, Gerald Montgomery, President of AbTech Corporation, stated "Of all the organizations we have encountered who claim that they are responsible for transitioning technology, yours is the first that has actually helped us achieve practical results." A recent issue of R&D Magazine featured SDI technology transfer efforts and elicited over 350 responses for more information from SDIO. Dr. Douglas Mooser, Principal Analyst, Congressional Budget Office, recently said, "The SDI Technology Applications Program is one of the most dynamic technology transfer programs in the Federal R&D sector."

2.3.3 Congressional Direction Relating to Far-Term Technologies

In response to the congressional direction to transfer management and budget responsibility for far-term follow-on technologies to the Defense Advanced Research Projects Agency or the Services, unless the Secretary of Defense certifies such technology transfers would not be in the U.S. national security interest, SDIO recommends transfer of the Free Electron Laser program to the Army. SDIO has transferred a significant portion of the theater boost phase technology program to the Air Force to demonstrate the feasibility of an airborne laser concept. Other key follow-on technology programs will be retained in SDIO.

2.4 Management Approach

Transitioning from a research, development, testing, and evaluation (RDT&E) program to an acquisition program dictates a more structured management arrangement. Under a formal Memorandum of Agreement (MOA) established between SDIO and each Service, SDIO is accountable and responsible for overall system performance and integration, and for all program direction including architectures, funding allocation, and acquisition strategy. Under SDIO direction, the Services will acquire the elements using their existing management infrastructure and acquisition policies and procedures.

As reflected in the MOA, the Director, SDIO and the SDI Acquisition Executive is responsible and accountable to the Secretary of Defense and to the Under Secretary of Defense for Acquisition for the architecture and acquisitions of strategic and theater missile defense systems. Day-to-day execution of the strategic and theater programs is the responsibility of a senior military officer -- to be called the General Manager -- who will report to the Director, SDIO. With support from the systems engineering and integration contractor, he will be responsible for overall configuration management, system configuration control, and overall battle management, command, control, and communications system development.

Each of the Military Departments has centralized its program execution activities under a single Program Executive Officer (PEO) accountable to the Service Acquisition Executive to ensure a smooth development process that integrates across Service lines, but within the framework of the normal Service processes, procedures, and regulations. Service element program managers will report to the PEOs and execute their programs in accordance with direction that flows from the General Manager.

2.5 Conclusion

The Department of Defense continues to emphasize the priority of building upon the Missile Defense Act of 1991 to form a bipartisan base of support for developing and deploying defenses against limited ballistic missile attacks for the American people, our forces abroad and our friends and allies. While there have been some adjustments resulting from the FY 1993 Defense Authorization Act, the basic programs and objectives set in place by the MDA are still valid.

The modified strategy discussed here reflects the changes in the basic program logic set forth in our July 2, 1992 plan, which was endorsed by Congress as a low-to-moderate risk/concurrency program. The revised plan stretches out the program for deploying an initial defense of the United States by about 18 months to 2004, while continuing to plan for an option to field a contingency capability in 2000, should the threat indicate that such an option is warranted.

The Department's strategy also includes a follow-on technology and research program to provide alternatives and options for responding to future, advanced threats. It does, however, reduce the nation's directed energy weapons funding to the lowest level in over 20 years and reduces to a follow-on technology demonstration program the R&D efforts to provide an option for space based interceptors.

Chapter 3

Program Element Descriptions

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Chapter 3

Program Element Descriptions

This chapter responds to subparagraph (b)(2) of Section 224 of the National Defense Authorization Act for Fiscal Years 1990 and 1991 (Public Law 101-189), which requests "A detailed description of each program or project which is included in the Strategic Defense Initiative or which otherwise relates to defense against strategic ballistic missiles, including a technical evaluation of each such program or project and an assessment as to when each can be brought to the stage of full scale engineering development (now engineering and manufacturing development) (assuming funding as requested or programmed)" and to subparagraph (b)(4) which requests "An explanation of the relationship between each such [deployment] phase and each program and project associated with the proposed architecture for that phase."

3.1 Introduction

Four major program elements are used to integrate all Strategic Defense Initiative projects. A description of the four Program Elements is provided in section 3.2, and Table 3-1 summarizes the programs, projects, and activities funded through these program elements, with a description of their mission, functions and deployment phase.

3.2 SDI Program Elements

3.2.1 Program Element: 0603215C - Limited Defense System

The Limited Defense System (LDS) PE includes programs, projects, and activities (and supporting programs, projects, and activities) which have as a primary objective the development of systems, components, and architectures for a deployable anti-ballistic missile system that is capable of providing a highly effective defense of the United States against limited ballistic missile threats, including accidental or unauthorized launches or Third Country attacks. For purposes of planning, evaluation, design, and effectiveness studies, such programs, projects, and activities take into consideration both the current limitations of the Anti-Ballistic Missile (ABM) Treaty and modest changes to the Treaty's numerical limitations and its limitations on the use of space-based sensors.

Activities within the LDS PE are focused on developing highly effective defenses including possibly several ground-based interceptor sites and space-based sensors to protect the entire United States, including Alaska and Hawaii, against ballistic missile attacks consisting of up to several tens of reentry vehicles (RVs). Within this LDS framework, an ABM Treaty-compliant ballistic missile defense system located at a single site within the U.S. will be developed in accordance with the Missile Defense Act of 1991 and its amendment in the FY93 Authorization Act. Development for follow-on sites and Brilliant Eyes is also included.

Program Element Descriptions

Within this Program Element there are essentially three categories of activity: System Development; Risk Mitigation, Hedges, and P³I; and Threat Evaluation, Phenomonology, and Other Support.

The Systems Development category is made up of those activities that directly constitute formal development of the LDS system, including systems engineering, command and control, systems testing, and site preparation and construction. These are the principal activities that comprise the Major Defense Acquisition Programs (MDAPs) subject to oversight by the Defense Acquisition Executive.

The second category of Risk Mitigation, Hedges and P³I constitutes the technology program in direct support of the LDS development effort. These activities include efforts to develop improved passive sensors, enhanced signal processing techniques, and lighter and smaller interceptor components. Development of the Ground-Based Surveillance and Tracking System (GSTS) was included in this category. This program, a risk mitigation alternative sensor for the cueing of Ground Based Interceptors, could not be continued within the funding levels provided.

The remaining category, Threat Evaluation, Phenomonology, and Other Support, is to evaluate the threat, to improve the understanding of key phenomonology, particularly with respect to the discrimination problem, and to provide other critical support activities, including necessary targets and sensors required for testing. These efforts focus on improved sensor technologies for target discrimination and for developing realistic targets for testing the system.

3.2.2 Program Element: 0603214C Spaced-based Interceptors

The Space-Based Interceptor Program Element includes programs, projects, and activities that have as a primary objective the conduct of research on space-based, kinetic kill interceptors, such as Brilliant Pebbles, that could provide an overlay to ground-based ABM interceptors.

Although not a part of the initial limited defense system, space-based interceptors offer the potential for a cost-effective means of providing highly effective protection, on a global basis, against limited missile attack. This Program Element, which previously included systems development, risk mitigation and scientific studies towards spaced-based interceptors, has been realigned to continue Brilliant Pebbles (BP) research as an extended demonstration/validation program geared towards a future, follow-on option for ballistic missile defense.

3.2.3 Program Element: 0603217C Other Follow-On Systems

The Other Follow-On Systems Program Element includes programs, projects, and activities that have as a primary objective the development of technologies capable of supporting systems, components, and architectures that could produce highly effective defenses in the future. Projects funded in this Program Element lay the foundation to develop defensive systems that provide significant added performance capabilities for countering potential future threats that may well increase in both number and sophistication. This Program Element includes two categories of effort: Directed Energy and Other Advanced Technologies.

The Directed Energy efforts are pursuing high-energy laser and particle beam technologies which will support the development of systems capable of near-speed-of-light intercept, interactive target discrimination, and continuous worldwide coverage.

Included in the technologies being investigated are advanced sensors and interceptors. The sensor efforts focus on demonstrating acquisition, tracking, and discrimination capabilities from small sensor platforms. Advanced interceptor technology includes research in the field of hypervelocity projectiles with a focus on gun-launched projectiles that use electricity and magnetism to accelerate projectiles to very high speeds sufficient to destroy an attacking missile on impact. This technology offers a multiple-shot capability, a reusable launcher, and low-cost projectiles.

Other FY1993 efforts will focus on advanced power and power conditioning systems, and Single Stage Rocket Technology (SSRT), previously known as Single Stage To Orbit (SSTO).

3.2.4 Program Element: 0603218C Research and Support Activities

The Research and Support Program Element contains three categories of activities: Research; General Test And Evaluation; and Program Support for activities in one or more of the other program elements. The Research category was markedly reduced in 1992 by aligning the efforts more closely with program objectives of the other Program Elements and funding that research from those Program Elements. The remaining efforts focus on exploring innovative science and technologies of potential interest to ballistic missile defense and continued intelligence efforts to characterize the evolving ballistic missile threat and potential countermeasures to missile defense systems.

General Support includes general studies and overall management support. This category pays for management support to SDIO as well as salaries, buildings, and basic management support within the executing services and agencies. In compliance with Congressional limitations on support services imposed in the 1993 Authorization Act, management support was reduced by 15% from requested levels.

3.2.5 Program Element Status Summary

Table 3-2 provides a summary listing of the programs and projects by Program Element and the realigned FY1993 planned budget levels. A narrative description and a technical assessment of each program and project is provided in Appendix to this report. Table 3-3 provides a summary relating the next program milestones for major programs and the estimated costs to achieve these milestones.

Program Element Descriptions

Table 3-1
Correlation Of GPALS Functional Areas And SDI Program Support
Activities With Projects, Program Elements, And Possible
Deployment Phases

GPALS Functional Areas And Program Support Activities	Projects	Program Elements				GPALS Deployment Phases	
		LDS	SBI	Follow-on	Research And Support	Initial	Potential Follow-on
Sense An Attack	1101 Passive Sensor	•				•	
	1102 Radar	•				•	
	1103 Laser Radar Technology	•					•
	1104 Signal Processing	•				•	
	1105 Discrimination	•				•	
	1106 Sensor Studies	•					
	1110 Sensor Integration	•			•		•
	1601 IST						
	2102 Brilliant Eyes	•				•	
	2103 GSTS	•				•	
	2104 GER	•					
	3109 System Security	•				•	
	3110 Survivability Eng	•					
	3111 Surveillance Eng	•				•	
	3307 AOA / AST						
Control, Operate, And Integrate	1403 Computer Eng	•				•	
	1405 Communications Eng	•			•	•	•
	1601 IST	•				•	
	2300 Command Center	•				•	
	2304 Software Eng	•					
Engage And Destroy - Strategic	1208 Discriminating Interceptor	•				•	•
	1209 Endo Tech	•				•	
	2202 CBI	•	•				•
	2205 Brilliant Pebbles						
Engage And Destroy - Follow-on	1201 Int Comp Tech	•		•			•
	1202 Exo LEAP	•		•			•
	1204 Int Study & Analysis	•					•
	1212 D-2 Program			•			
	1301 FEL			•			•
	1302 Chem Laser			•			•
	1303 NPB Tech			•			•
	1305 ATP / FC			•			•
	1307 DE Demo			•			•
	1601 IST						•
	1602 SBIR						•
Support With Key Technology	1502 Lethality	•	•	•	•	•	•
	1503 Power Cond	•		•		•	•
	1504 Mats & Structures	•		•		•	•
	1601 IST			•			•
	2106 ATS				•		

Table 3-1
Correlation Of GPALS Functional Areas And SDI Program Support
Activities With Projects, Program Elements, And Possible
Deployment Phases (Cont'd)

GPALS Functional Areas And Program Support Activities	Projects	Program Elements				GPALS Deployment Phases	
		LDS	SBI	Follow-on	Research And Support	Initial	Potential Follow-on
Perform System Analysis, Engineering And Testing	1501 Survivability	•				•	
	1502 Lethality	•	•	•		•	•
	1504 Materials & Structures			•	•	•	•
	1701 Launch Services	•					•
	1702 Spec Test Acts			•			•
	1703 Tech Sat			•			•
	2304 Software Engineering	•				•	
	3102 Sys Engineering	•				•	
	3103 SDI Metrology	•				•	
	3104 ILS	•				•	
	3105 Prod & Manufacture	•			•	•	
	3107 Environmental Siting & Facilities					•	•
	3108 Operational Environments	•				•	
	3109 Sys Sec Engineering	•				•	
	3110 Survivability Engineering	•				•	
	3111 Surveillance Engineering	•				•	
	3112 Systems Engineering Mod	•				•	
	3113 Ground Common	•				•	
	3201 System Arch	•				•	•
	3202 Ops Interface	•				•	•
	3203 Threat Development				•	•	•
	3204 Countermeasures				•	•	
	3206 System Threat	•				•	
	3207 Systems Analysis						
	3301 Data Center	•		•		•	•
	3302 System Test Environment	•				•	
	3303 Ind T / E Oversight	•				•	
	3304 Targets	•			•	•	
	3306 ARC	•				•	
	3307 AOA / AST	•				•	
	3308 System Simulator	•				•	
	3309 System Test Plan / Exec	•				•	
	3313 Test Range	•				•	
	3314 Op Test Support	•				•	
Manage	3310 Test Facility	•		•		•	
	3311 Mob Test Assets	•				•	
	3312 NTB Support	•				•	
	4000 Op Support	•	•	•		•	•
	4302 Tech Transfer				•		
	4305 Min Acc For PET			•			

Program Element Descriptions

Table 3-2
Program Element Key Activities
(In Millions Of Then Year Dollars)

PMA	Title	FY 93
Limited Defense System		
<i>Systems Development</i>		
3102	System Engineering	71.184
3103	SDI Mat	2.350
3104	ILS	2.920
3105	Manufacturing & Producibility	8.839
3109	Systems Security	12.295
3110	Survivability Engineering	.400
3111	Surveillance Engineering	4.950
3308	System Simulator	7.398
3309	System Test / Plan	31.215
2300	Command Center	52.348
2304	Software Engineering	6.425
3112	System Engineering Modeling	10.770
2102	BE	241.000
2104	GER	90.355
2202	GBI	142.400
4201	System Engineering Mgmt	<u>12.273</u>
	Subtotal	697.122
<i>Risk Mitigation, Hedges And P I³</i>		
1101	Passive Sensors	21.780
1102	Radar	10.305
1104	Signal Processing	18.510
1201	Interceptor Component Tech	14.985
1202	Interceptor Integration	141.242
1204	Interceptor Studies	7.500
1208	Discriminating Interceptor	0.200
1209	Endo Technology	18.910
1405	Comm Engineering	11.285
1503	Power	0.825
1504	Materials & Structures	11.065
2103	GSTS	10.500
1403	Comp Engineering	3.720
1701	Launch Services	<u>30.075</u>
	Subtotal	300.902
<i>Threat Evaluation, Phenomenology And Other Support</i>		
1105	Discrimination	88.633*
1106	Sensor Studies & Exp	141.744
1110	Sensor / Integration	48.670
1501	Survivability	25.160
1502	Lethality	4.725
3102	System Engineering	21.075
3304	Targets	67.370
3307	AST	37.830
3207	System Analysis	12.200
4000	Operational Support	<u>31.993</u>
	Subtotal	479.400

* Includes MILCON

Table 3-2 (Cont'd)
Program Element Key Activities
(In Millions Of Then Year Dollars)

PMA	Title	FY 93
<i>Limited Defense System (Cont'd)</i>		
	<i>Critical Support Activities</i>	5.020
3115	System Engineering	4.170
3201	Arch Studies	8.191
3202	Ops Interface	10.000
3301	Data Centers	91.060
3302	NTB	3.758
3303	T & E Planning	17.020
3306	ARC	25.320
3310	Test Facility	16.410
3311	Mobile Test	7.446
3312	NTB Support	19.965
3313	Test Range	0.925
3314	Op Test Support	12.015
4000	Op Support	
	Subtotal	221.300
	LDS Total	1,698.724
 <i>Space Based Interceptors</i>		
	<i>Systems Development</i>	245.960
2205	Brilliant Pebbles	20.040
4000	Operational Support	
	Subtotal	266.000
	 <i>Threat Evaluation, Phenomenology, And Other Support</i>	4.000
1502	Lethality	
	Subtotal	4.000
	SBI Total	270.000

Program Element Descriptions

Table 3-2 (Cont'd)
Program Element Key Activities
(In Millions Of Then Year Dollars)

PMA	Title	FY 93
Other Follow-on Systems		
<i>Directed Energy</i>		
1301	FEL	14.182
1302	Chemical Laser	69.414
1303	NPB	38.146
1305	ATP/FC	19.367
1307	DE Demo	22.408
4000	Operational Support	5.000
	Subtotal	168.517
<i>Other Advanced Technologies</i>		
1201	Interceptor Components	2.500
1202	Interceptor Integration	44.023
1212	D-2 Program	10.000
1502	Lethality	1.551
1503	Power	22.879
1504	Materials And Structures	2.400
1702	Spec Test Act	32.260
2106	ATS	20.435
3301	Data Centers	2.990
3311	Test Assets	.850
4305	PET	.500
	Subtotal	140.388
	OFO Total	308.905
Research And Support		
<i>Research</i>		
1503	Pwr And Pwr Conditioning	21.600
1504	Materials And Structure	10.150
1601/2	IS & T/SBIR	127.157
3203	Intel Threat	14.875
3204	Countermeasures	17.296
3206	System Threat	9.631
4302	Technology Transfer	2.239
	Subtotal	202.109
<i>Test And Evaluation</i>		
3304	Targets	13.150
<i>Support</i>		
3107	Environmental Siting	5.600
4000	Operational Support	203.212
	Subtotal	208.812
	R&S Total	424.071

Table 3-3
Estimated Funding Required To Meet Next Milestone
(In Millions Of Then Year Dollars)

Program / Project	Required After FY 1995	Description Of Next Milestone	Date
2102 Brilliant Eyes	668	Milestone II	1998
2104 National Missile Defense- Ground Based Radar	67	Milestone II	1998
2202 Ground Based Interceptor	1469	Milestone II	1998
2300 Command Center	714	Milestone II	1999

Chapter 4

Program Funding



Chapter 4

Program Funding

This chapter responds to subparagraph (b)(8) of the National Defense Act for Fiscal Years 1990 and 1991 (Public Law 101-189), which requests "Details regarding funding of programs and projects for the Strategic Defense Initiative (including the amounts authorized, appropriated and made available for obligation after undistributed reductions or other offsetting reductions were carried out), as follows:

- (A) The level of requested and appropriated funding provided for the current fiscal year for each program and project in the Strategic Defense Initiative budgetary presentation materials provided to the Congress.
- (B) The aggregate amount of funding provided for previous fiscal years (including the current fiscal year) for each such program and project.
- (C) The amount requested to be appropriated for each such program and project for the next fiscal year.
- (D) The amount programmed to be requested for each such program and project for the following fiscal year.
- (E) The amount required to reach the next significant milestone for each demonstration program and each major technology program."

4.1 Introduction

Table 4-1 provides the requested SDI budget summary. All programs and projects directly supporting strategic defense are listed. Included are those technology efforts which support both strategic and theater missile defense. The funds indicated reflect the total funds directed towards the technology effort. As with all chapters of this report, funding associated exclusively with Theater Missile Defense is not included but is addressed in the separate TMDI Report to Congress.

Program Funding

Table 4-1
Project Funding Profile
(In Millions Of Than Year Dollars)

Project Number And Title	Funds Expended Through FY 1992	FY 1993 Current SDI*	FY 1994 Request SDI*	FY 1995 Request SDI*
1101 Passive Sensors	451	22	44	37
1102 Microwave Radar	115	10	13	17
1103 Laser Radar Technology	445	0	13	13
1104 Signal Processing	534	19	32	34
1105 Discrimination	1093	74	105	115
1106 Sensor Studies And Experiments	960	142 (6)	168 (5)	120 (5)
1110 Sensor Integration	21	49	49	37
1201 Interceptor Component Technology	530	17	16	37
1202 Interceptor Integration Technology	591	185	65	60
1204 Interceptor Studies And Analysis	662	8	10	11
1208 Discriminating Interceptor	0	1	50	55
1209 Endoatmospheric Interceptor Technology	50	19	65	85
1212 D-2 Program	6	10	10	0
1301 Free Electron Laser	1042	14	0	0
1302 Chemical Laser Technology	869	69	43	38
1303 Neutral Particle Beam Technology	725	38	20	39
1305 Acquisition, Tracking, Pointing And Fire Control Technology	1452	19	20	25
1307 Directed Energy Demonstration	0	22	15	24
1403 Computer Engineering	2	4	1	1
1405 Communications Engineering	22	11	22	20
1501 Survivability Technology	552	25 (3)	68 (6)	80 (5)
1502 Lethality And Target Hardening	479	10 (28)	4 (37)	5 (37)
1503 Power And Power Conditioning	486	45	70	60
1504 Materials And Structures	162	24	20	20
1601 Innovative Science And Technology	645	83	86	88
1602 New Concepts Development	183	44	54 (32)	85 (47)
1701 Launch Services	83	30	128	123
1702 Special Test Activities	54	32	5	0
1703 Techsat	0	0	25	36
2102 Brilliant Eyes	436	241	170 (136)	189 (154)
2103 Ground Based Surveillance And Tracking System	230	11	0	0
2104 Ground Based Radar	349	91 (112)	379 (195)	283 (143)
2106 ATS	32	21 (69)	0 (53)	0 (88)

* () TMDI Funding For Project

Table 4-1
Project Funding Profile (Cont'd)
(In Millions Of Then Year Dollars)

Project Number And Title	Funds Expended Through FY 1992	FY 1993 Current SDI*	FY 1994 Request SDI*	FY 1995 Request SDI*
2202 Ground Based Exoatmospheric Interceptor Development	882	110	571	772
2205 Brilliant Pebbles	909	246	336	339
2300 Command Center	727	52	53 (6)	262 (32)
2304 System Software Engineering	8	6	7	20
3102 System Engineering	281	97	82 (7)	117 (11)
3103 SDIO Metrology	2	2	2	3
3104 Integrated Logistics Support	48	3	4	6
3105 Producibility & Manufacturing	38	9	10	20
3107 Environment, Siting & Facilities	63	6	17	22
3108 Operational Environments	3	0	1	1
3109 System Security Engineering	19	12	13	24
3110 Survivability Engineering	3	1	2	9
3111 Surveillance Engineering	16	5	5	13
3112 System Engineering Modeling	27	11	15	32
3113 Ground Common	14	0	5	3
3201 Architecture And Analysis	194	4	5	6
3202 Operations Interface	37	8	9	10
3203 Intelligence Threat Development	80	15	10	11
3204 Countermeasures Integration	126	17 (1)	23	24
3206 System Threat	15	9	10	11
3207 Systems Analysis	39	12	7	8
3301 SDIO Test Data Centers	13	13 (0)	12 (7)	13 (9)
3302 System Test Environment	627	91	61	63
3303 Test & Evaluation Planning	20	4	7	7
3304 Targets	432	132 (21)	228 (71)	187 (77)
3306 Computer Resources And Engineering	68	17	24	29
3307 Airborne Surveillance Test Bed	663	38	45	0
3308 System Simulator (Level 1 And 2)	15	7	5	10
3309 System Test Planning And Execution	24	31	111	292 (9)
3310 T&E Facilities And Launch Support	44	25 (1)	21 (10)	15 (15)
3311 Mobile Test Assets	12	18	16 (7)	12 (12)
3312 System Test Environment Support	12	7	8	8
3313 Test Ranges	0	21	31 (15)	22 (23)
3314 OP Test Support	0	1	0	0
4000 Operational Support Costs	1437	285	382 (61)	414 (81)
4302 Technology Transfer	3	2	3	3
4305 Miniaturized Accelerators For PET	60	1	0	0

* () TMDI Funding For Project

Chapter 5

ABM Treaty Compliance



Chapter 5

ABM Treaty Compliance

This chapter responds to subparagraph (b)(6) of Section 224, National Defense Authorization Act for Fiscal Years 1990 and 1991 (Public Law 101-189), which requests "A statement of the compliance of the planned SDI development and testing programs with existing arms control agreements, including the 1972 Anti-Ballistic Missile Treaty."

5.1 Introduction

The 1972 Anti-Ballistic Missile (ABM) Treaty addresses the development, testing, and deployment of ABM systems and components. It should be noted that nowhere does the ABM Treaty use the word "research." Neither the United States nor the Soviet delegation to the Strategic Arms Limitation Talks (SALT I) negotiations chose to place limitations on research, and the ABM Treaty makes no attempt to do so. The United States had traditionally distinguished "research" from "development" as outlined by then-U.S. delegate Dr. Harold Brown in a 1971 statement to the Soviet SALT I delegation. Research includes, but is not limited to, conceptual design and laboratory testing. Development follows research and precedes full-scale testing of systems and components designed for actual deployment. Development of a weapon system is usually associated with the construction and field testing of one or more prototypes of the system or its major components. However, the construction of a prototype cannot necessarily be verified by national technical means of verification. Therefore, in large part because of these verification difficulties, the ABM Treaty prohibition on the development of sea-, air-, space- or mobile land-based ABM systems, or components for such systems, applies when a prototype of such a system or its components enters the field-testing stage.

The ABM Treaty regulates the development, testing, and deployment of ABM systems whose components were defined in the 1972 Treaty as consisting of ABM interceptor missiles, ABM launchers, and ABM radars. ABM systems based on other physical principles and including components capable of substituting for ABM interceptor missiles, ABM launchers, or ABM radars are addressed only in Agreed Statement D. In order to fulfill the basic Treaty obligation not to deploy ABM systems or components except as provided in Article III, this agreed statement provides that in the event that ABM systems based on other physical principles and including components capable of substituting for ABM interceptor missiles, ABM launchers, or ABM radars are created in the future, specific limitations on such systems and their components would be subject to discussion in accordance with Article XIII and agreement in accordance with Article XIV of the Treaty. The Agreed Statement does not proscribe the development and testing of such systems, regardless of basing mode. The SDI Program will continue to be conducted in a manner that fully complies with all U.S. obligations under the ABM Treaty.

Research and certain development and testing of defensive systems are not only permitted by the ABM Treaty but were anticipated at the time the Treaty was negotiated and signed. Both the United States and the Union of Soviet Socialist Republics supported this position in testimony to their respective legislative bodies. When the Treaty was before the Senate for advice and consent

to ratification, then-Secretary of Defense Melvin Laird advocated, in his testimony, that the United States "vigorously pursue a comprehensive ABM technology program." In a statement before the Presidium of the Supreme Soviet, Marshall Grechko said the ABM Treaty "places no limitations whatsoever on the conducting of research and experimental work directed toward solving the problem of defending the country from nuclear missile strikes."

5.2 Existing Compliance Process For SDI

The Department of Defense (DOD) has in place an effective compliance process (established with the SALT I agreements in 1972) under which key offices in DOD are responsible for overseeing SDI compliance with all the United States arms control agreements. Under this process, the SDI organization (SDIO) and DOD components ensure that the implementing program offices adhere to DOD compliance directives and seek guidance from offices charged with oversight responsibility.

Specific responsibilities are assigned by DOD Directive 2060.1, July 31, 1992, "Implementation of, and Compliance With, Arms Control Agreements." The Under Secretary of Defense (Acquisition), USD(A), ensures that all DOD programs are in compliance with United States arms control agreements. The Service secretaries, the Chairman of the Joint Chiefs of Staff, and agency directors ensure the internal compliance of their respective organizations. The DOD General Counsel provides advice and assistance with respect to the implementation of the compliance process and interpretation of arms control agreements.

DOD Directive 2060.1 also establishes procedures for ensuring the continued compliance of all DOD programs with existing arms control agreements. Under these procedures, questions of interpretation of specific agreements are to be referred to the USD(A) for resolution on a case-by-case basis. No project or program which reasonably raises a compliance issue can enter into the testing, prototype construction, or deployment phase without prior clearance from the USD(A). If such a compliance issue is in doubt, USD(A) approval shall be sought. In consultation with the office of the DOD General Counsel, Office of the Assistant Secretary of Defense for International Security Policy, and the Joint Staff, USD(A) applies the provisions of the agreements, as appropriate. DOD components, including SDIO, certify internal compliance periodically and establish internal procedures and offices to monitor and ensure internal compliance.

In 1985, the United States began discussions with allied governments regarding technical cooperation on SDI research. To date, the United States has concluded bilateral SDI research Memoranda of Understanding (MOUs) with the United Kingdom, Germany, Israel, Italy, and Japan. All such agreements will be implemented consistent with the United States' international obligations, including the ABM Treaty. The United States has established guidelines to ensure that all exchanges of data and research activities are conducted in full compliance with the ABM Treaty obligations not to transfer to other states ABM systems or components limited by the Treaty, nor to provide technical descriptions or blueprints specially worked out for the construction of such systems or components.

5.3 SDI Experiments

All SDI field tests must be approved for ABM treaty compliance through the DOD compliance review process. The following major programs and experiments, all of which involve field testing, have been approved and are to be conducted during the remainder of FY 1993 and FY 1994: Laser Atmospheric Compensation Experiment (LACE); flights throughout FY 1993-1994 in the Airborne Surveillance TestBed (AST) program, a revision of the Airborn Optical Adjunct project; the Lightweight Exoatmospheric Projectile (LEAP) III and IV flight experiments; Navy LEAP FTV 2-3; SRAM (Short-Range Attack Missile) LEAP flight tests 1-2; Brilliant Pebbles Flight Experiments 1M and 1T, Brilliant Pebbles Tether Tests, and Brilliant Pebbles target development flight tests; High Altitude Balloon Experiments (HABE) and Kestrel experiments; Patriot Pre-Planned Product Improvements (P3I); Extended Range Interceptor (ERINT) program flight experiments; Airborne Atmospheric Compensation and Tracking TestBed (AACT) experiments in the Airborne Laser project; Single Stage Rocket Technology (formerly called the Single-Stage-To-Orbit) experiment; TechSat-A satellite bus; the Midcourse Space Experiment (MSX); AEGIS SPY-1 radar and Standard Missile SM II (Block 4) modifications; RAPTOR unmanned aerial vehicle (UAV) D-1 platform testing; the Pathfinder Solar Electric aircraft Test Platform (SETP) in the RAPTOR/TALON project; Electrothermal Chemical (hypervelocity) Gun integration field-tests at Yuma Proving Grounds; Miniature Seeker Technology Integration (MSTI) Satellite Development Program MSTI flights 2-3; and the Israeli Arrow interceptor development program known as the Arrow Continuation Experiments (ACES).

The following major projects and experiments have been approved for later years, subject, in some cases, to review of more completely defined experiments: Deep Space Program Experiment (Project Clementine flights II and III); the Ground-Based Radar (NMD GBR-T demval); Topaz II Flight Tests; and the Neutral Particle Beam Space Experiment (NPBSE).

In addition, the following data collection activities continue to be approved: the Optical Airborne Measurement Program (OAMP) and High Altitude Observation aircraft (HALO and ARGUS); Cobra Judy; Godiva; Cobra Ball; Red Gemini VII-VIII; Aerothermal Reentry Experiments (ARE-2H and ARE-3); Ultraviolet Plume Instrument (UVPI) and Army Background Experiment; Zodiac Beauchamp; Red Tigress II-IV; Polar Ozone Aerosol Measurements (POAM) II experiment; TMD Countermeasures Mitigation Program (TCMP); Space Power Experiments Aboard Rocket (SPEAR) III; Combined Optical Measurements Experiment Tests (COMET); Rapid Optical Beam Steering (ROBS) System (formerly called the Transportable LADAR System); Project Caesar; Deep Space Program Experiment (Project Clementine Flight I); and Shuttle Pallet Satellite (SPAS) III. The following projects have been approved but are not funded for FY 1993-94: Sounding Rocket Measurement Program (SRMP); the Firebird/Firefly experiments; and the Vehicle Interactions Program (VIP). The System Integration Test (SIT 1) planned for FY 1993 utilizes data collected by a variety of sensor systems for simulation and integration planning purposes; follow-on SITs will be examined for Treaty compliance as their experiments are better defined.

The following projects have approved activities that are not considered to be in field testing: Average Power Laser Experiment (APLE); Alpha/LAMP Integration; and Hypervelocity Gun (HVG) projects. Also, the National Test Bed including the Experiment Control Center (CERES) has been determined to be compliant with the ABM Treaty.

ABM Treaty Compliance

The following target development projects have been approved: Strategic Target System (STARS); Operational and Developmental Experiments Simulator (ODES); STORM Ballistic Tactical Target Vehicle (BTTV) flights (formerly called the ERINT Target System development project); and the Target Development Tests. The Brilliant Pebbles Target Launch Vehicle Demonstration has been approved and may be re-conducted. All SDI launches are reviewed for compliance with the research and development launch provisions of the 1987 Intermediate-Range Nuclear Forces Treaty. Such launches will be notified to the Nuclear Risk Reduction Center of the former Soviet Union as required.

The following programs, some of which have not been sufficiently defined for compliance review, are not yet approved: Brilliant Pebbles flight tests 2M, 3M, 4M, 2T, and 3T; Navy LEAP FTVs 4-11; SRAM (Short Range Attack Missile) LEAP flight tests 3-5; Bowshock III; the Ground-Based Interceptor (GBI) (formerly the Exoatmospheric Reentry Vehicle Interceptor Subsystem or ERIS) flight experiments; Theater High Altitude Area Defense (THAAD); the Ground-Based family of radars (NMD-GBR UOE and TMD-GBR); Corps SAM; Brilliant Eyes flight tests; Miniature Seeker Technology Integration (MSTI) 4 experiment; RAPTOR UAV D-2 testing, and TALON kinetic-energy kill vehicle (KKV) "tethered" ALPHA TALON testing and BETA atmospheric flight-tests; TechSat-A satellite testbed platform experiments; and the Theater Missile Target Program. Software upgrades for U.S. Early Warning Radars are currently under compliance review.

We are planning to develop and deploy theater/tactical missile defense systems to counter the projected threat to our forces abroad and to our allies. Although the objective of the ABM Treaty is to limit defenses against strategic ballistic missiles, there may be conflicts between the Treaty and the development and deployment of some of the theater/tactical defense systems under consideration. We are currently studying this issue.

Currently, no experiment has been approved that would not fall within the categories used in Appendix D to the 1987 Report to Congress on the Strategic Defense Initiative. Changes to previously approved experiments require compliance review.

Chapter 6

Other Nation Participation



Chapter 6

Other Nation Participation

This chapter responds to subparagraph (b)(5) of the National Defense Authorization Act for Fiscal Years 1990 and 1991 (Public Law 101-189), which requests "The status of consultations with other member nations of the North Atlantic Treaty Organization, Japan, and other appropriate allies concerning research being conducted in the Strategic Defense Initiative Program."

6.1 Consultations

Since the beginning of the SDI program, the U.S. has consulted with allied and friendly nations on SDI research, development, testing, and deployment plans. When the SDI program was re-focused toward GPALS in 1991, U.S. officials conducted numerous briefings abroad and in the U.S. to inform and to consult with our allies and friends on this new direction for ballistic missile defense. This consultation, including discussions on the Global Protection System (GPS) concept agreed at the June 1992 U.S.-Russian Summit, continues. Following that Summit, meetings and discussions were held with both allies and friends on the GPS concept and its relationship to the GPALS program. Details of these consultations are addressed in Chapter 1.

6.2 Research Participation

From the beginning of allied and friendly nation participation in the SDI research effort in 1985, the U.S. technology base has reaped many benefits over a wide range of technologies. As in prior years, the success of such participation is demonstrated through present and new contractual efforts. Currently, trends in allied involvement in the SDI program are toward theater missile defense-related activities, and test bed and technology experiments. This continuing and comprehensive involvement with allies will help underpin future efforts, particularly if and when allied and friendly nations take their own decisions to begin the development of missile defenses.

6.3 Summary Of Past, Present And New Efforts

Using established ground rules for participation, such as laws and policies governing rights to research results, SDIO has engaged and continues to engage in a wide variety of efforts with allied and friendly nations' governments and research entities. A summary of the past, present and recently begun efforts follows:

Other Nation Participation

Country	Past And Present Efforts	New Efforts
France	Sensors, Theater Defense Architectures, Free-electron Lasers, Klystrons, Rocket Propulsion Components And Casings	Extended Air Defense Simulations
Germany	Pointing / Tracking, Optics, Lethality And Target Hardening, Electron Lasers, Theater Defense Architectures, Infrared Phenomenology	None (Discussions On Extended Air Defense Test Bed)
Israel	Electrochemical Propulsion, Magnetohydrodynamics, Shortwave Chemical Lasers, ATBM Interceptors (ARROW), Test Bed, Theater Defense Architectures	ARROW Continuation Experiments (ACES), Test Bed Experiments
Japan	Superconducting Magnetic Energy Storage, Josephson Junction Microprocessor, Diamond Optics, Electric Propulsion, Western Pacific Architecture Study	—
Netherlands	Theater Defense Architecture, Electromagnetic Launchers	Extend Electromagnetic Launcher MOA For Another Five Years
UK	Optical / Electron Computing, Thyratrons, Ion Sources And Power Conditioning, Electromagnetic Launchers, Optical Logic Arrays, Countermeasures And Penetration Aids, UK Test Bed, Theater Defense Architecture Analysis	Advanced Lethality Technology
Belgium	Theater Defense Architecture, Laser Algorithms, Mosaic Array Data Compression And Processing Module	—
Canada	Power System Material, Particle Accelerators, Theater Defense Architecture, Sounding Rockets	—
Denmark	Magnetic Optics For Free Electron Laser Beam Steering	—
Italy	Cryogenic Induction, Superconducting Magnetic Energy Storage, Millimeter-wave Radar Seeker, Theater Defense Architecture, Smart Electro-optical Sensor	—
Russia	(No Previous Efforts)	Electric Thrusters, TOPAZ Thermionic Nuclear Reactor, Tacitrons

6.4 Summary Of Participation

The annual funding for all research efforts with allied and friendly nations constitutes 2-3% of SDIO's budget. Cumulatively, since this participation began in 1985, almost \$800 million have been invested in these programs. About 20% of this total value has been funded by foreign participants through various cooperative research programs. The SDIO is currently engaged in a number of additional exploratory discussions with the goal of promoting continued foreign technical contributions to the ballistic missile defense effort.

Chapter 7

Countermeasures



Chapter 7

Countermeasures

This chapter responds to subparagraph (b)(7) of Section 224 of the National Defense Authorization Act for Fiscal Years 1990 and 1991 (Public Law 101-189), which requests "A review of possible countermeasures of the Soviet Union to specific SDI programs, an estimate of the time and cost required for the Soviet Union to develop each such countermeasure, and an evaluation of the adequacy of the SDI programs described in the report to respond to such countermeasures."

7.1 Introduction

In recognition of the changing international security environment, the countermeasures program has intensified its focus on the Third World while continuing to investigate potential Commonwealth of Independent States (CIS) responses to U.S. BMD architectures. The SDI Countermeasures Integration (CMI) Program has directed most of its efforts to examining the less sophisticated counters that could be taken to defeat ground-based missile defense systems. Central to these efforts has been the gathering of data on the technologies and resources available to the world at large, particularly with the demise of the Soviet Union. Having identified several potential relatively simple countermeasures, the CMI Program is moving to evaluate and verify their credibility and impact on the GPALS elements. The emphasis in this report, however, is on the strategic missile systems and the countermeasures they might employ, principally against the NMD segment of GPALS. Work on theater missile defense countermeasures is discussed in the separate report on the Theater Missile Defense Initiative.

7.2 The Commonwealth Of Independent States

While the breakup of the Soviet Union has reduced the likelihood of a deliberate massive ballistic missile attack against the United States, continuing turmoil in the former Soviet Union has increased the risk of ballistic missile and related technologies proliferation. To date, the major emphasis of the non-TMD countermeasures effort has been on analyzing the capabilities of the Russian Federation as the principal successor nuclear power. Continuing studies of Russian industrial capabilities have shown a decreasing ability to field advanced countermeasures on current and projected missile systems in the next decade. Expectations are that only those countermeasures postulated to be on currently fielded systems, with perhaps minor changes, will be available in the GPALS deployment epoch. Should relations between the United States and Russia deteriorate, Russia may consider and possibly pursue countermeasures leading to a future capability to reconstitute their offensive forces.

The earlier export of such missile systems as the Scud, along with the general availability of ballistic missile technology, have made Russian expertise in system modification a valuable commodity in the Third World. The result of these circumstances is a growing concern, even by the Russians themselves, that such technologies and expertise may be the source of missile defense countermeasures in the Third World for years to come.

7.3 Countermeasures Evaluation And Criteria

The CMI Program has begun identifying potential countermeasures to the NMD architecture during 1992. The initial round of the Red/Blue exercise has commenced with the Red Team doing a vulnerability analysis of the NMD architecture. A small number of potential counters have been identified and further analysis to determine their credibility is underway. An additional round of the NMD Red/Blue exercise will be conducted in 1993. By understanding the full range of possible counters to BMD, measures can be taken to improve the performance and effectiveness of the defense.

During 1992 the CMI Program conducted several successful experiments to test countermeasure concepts. Most notable was the FIREBIRD 1B and the Countermeasures Demonstration Experiment missions. These experiments included the use of reentry vehicle masking and deception objects and provided significant data on flight dynamics, high altitude physics and chemical environments.

7.4 Summary And Conclusions

During 1992, the SDI Countermeasures Program continued to analyze potential countermeasures to BMD systems and architectures but in a new context from previous years. While a drastically different world situation faces us, there are still significant numbers of strategic systems of concern to the United States. These systems and the potential countermeasures that could be used with them in an accidental or intentional attack remain a serious threat to the United States and the effectiveness of a national missile defense system. The CMI Program will continue to coordinate with GPALS element and system designers to ensure that deployed defenses can respond effectively to a wide variety of counters.

Chapter 8

Relation Of SDI Technologies To Military Missions



Chapter 8

Relation Of SDI Technologies To Military Missions

This chapter responds to subparagraphs (b)(9) of Section 224 of the National Defense Authorization Act for Fiscal Years 1990 and 1991 (Public Law 101-189), which requests "Details on what Strategic Defense Initiative technologies can be developed or deployed within the next 5 to 10 years to defend against significant military threats and help accomplish critical military missions. The missions to be considered include the following:

- (A) Defending elements of the Armed Forces abroad and United States allies against tactical ballistic missiles, particularly new and highly accurate shorter-range ballistic missiles of the Soviet Union armed with conventional, chemical, or nuclear warheads.
- (B) Defending against an accidental launch of strategic ballistic missiles against the United States.
- (C) Defending against a limited but militarily effective attack by the Soviet Union aimed at disrupting the National Command Authority or other valuable military assets.
- (D) Providing sufficient warning and tracking information to defend or effectively evade possible attacks by the Soviet Union against military satellites, including those in high orbits.
- (E) Providing early warning and attack assessment information and the necessary survivable command, control, and communications to facilitate the use of United States military forces in defense against possible conventional or strategic attacks by the Soviet Union.
- (F) Providing protection of the United States population from a nuclear attack by the Soviet Union.
- (G) Any other significant near-term military mission that the application of SDI technologies might help to accomplish."

and subparagraph (b)(10) which requests that "for each of the near-term military missions listed in paragraph (9), the report shall include the following:

- (A) A list of specific program elements of the Strategic Defense Initiative that are pertinent to such missions.

Relation Of SDI Technologies To Military Missions

- (B) The Secretary's estimate of the initial operating capability dates for the architectures or systems to accomplish such missions.
- (C) The Secretary's estimate of the level of funding necessary for each program to reach those initial operating capability dates.
- (D) The Secretary's estimate of the survivability and cost-effectiveness at the margin of such architectures or systems against current and projected threats from the Soviet Union."

8.1 Introduction

This chapter discusses the application of SDI technologies to critical and/or significant military missions. The chapter also addresses the issue of the survivability of proposed defensive systems.

8.2 SDI Technologies And Illustrative Military Missions

This section addresses significant military missions that SDI technologies might help to accomplish. Significant military missions include air, maritime, ground, and space defense.

8.2.1 Air Defense

The North American air defense mission encompasses surveillance, warning, interception, and identification or negation of unknown aircraft and cruise missiles that penetrate the air defense identification zone. Systems that contribute to the air defense mission in the North American continent include the Joint Surveillance System network or Air Force and Federal Aviation Administration radars, the Distant Early Warning Line/North Warning system radars across Alaska and Canada, Over-the-Horizon Backscatter radar, Airborne Warning and Control System (AWACS) aircraft, and fighter-interceptors on continuous alert. SDI technologies could significantly improve air defense mission efficiency and effectiveness, especially against future threats.

North American air defense assets operate as a system, with one type of surveillance asset compensating for the deficiencies of others. Interceptor aircraft assist fixed surveillance sensors in identifying all tracks of incoming aircraft. In some cases, AWACS aircraft and interceptors perform surveillance when transient gaps occur in radar coverage. If fixed or aircraft-based sensors had greater capability, interceptors could be employed more effectively and efficiently. Improvements in sensor range, data processing, and operating efficiency would greatly facilitate the air defense mission.

Because aircraft can be diverted to many possible targets, discerning the objectives of an air-breathing attack is difficult. However, broad patterns of mass raids can be revealed if information from multiple sensors can be assimilated simultaneously. SDI's advances in survivable communications and distributed computation could significantly improve raid recognition, attack assessment, and efficient assignment of interceptors.

ment, and efficient assignment of interceptors.

The North American air defense surveillance mission could obtain substantial benefit from a variety of SDI efforts. SDI electrical power projects could provide long-term energy sources for unattended ground-based radar systems. Battle management and communications systems within the SDI Program could facilitate sensor data fusion and attack assessment. Improvements in aircraft-based compact data processing and sensor operations could greatly enhance airborne surveillance of air-breathing threats. Survivable, high-data-rate communication systems could help maintain connectivity among the air defense regions and improve the allocation of interceptors and sensors within and among regions.

Tactical air defense in a theater of operations is closely integrated with Theater Missile Defense (TMD) and includes sensors such as the AWACS and other (non-TMD) mobile ground-based radars. These sensors provide early warning and engagement control of Air Force air defense and Army anti-aircraft surface-to-air missile systems such as the PATRIOT (in its anti-aircraft role), HAWK, Stinger, and Chaparral, as well as Vulcan gun systems. The current air defense sensor/weapon configuration results in a highly decentralized command and control environment, which is further constrained by limitations in battle management/command, control and communications (BM/C3) technology.

Theater air defense operations depend on limited sensor and BM/C3 architectures, which are in turn affected by electronic countermeasures and raid size. Sensors incorporating sophisticated SDI technology would ensure sustained theater air defense operation and would preclude the operation's being hampered by countermeasures.

Theater air defense operations could also benefit from the development of SDI weapon technologies. For example, the extension of air defense systems to a more robust role could be derived from hypervelocity gun (HVG), laser, and kinetic-kill vehicle experiments. Early-warning attack assessment functions could benefit from sensor developments. Missile lethality enhancements could be based on improved lethality and vulnerability analyses. Command, control, and data processing could be improved as a result of the software development and signal data processing work being accomplished for the SDI Program. Reductions in size and weight of the missile components and better rocket motors and gun launch components would result in both increased range and higher probability of kill.

At the global level, SDI computer technologies and simulation display advances could help integrate air-breathing and missile threat information necessary to respond to combined attacks. SDI kinetic energy interceptor technologies may allow more intercepts with fewer aircraft. Sensor, kinetic energy interceptor, and battle management technologies pursued by the SDI Program could all be applicable to the strategic air defense missions.

8.2.2 Maritime Operations

The global maritime operations of U.S. naval units and fleets in peacetime and wartime are critically dependent on surveillance, communications, and the ability to intercept hostile forces beyond the range at which the forces can actively threaten fleet units.

Relation Of SDI Technologies To Military Missions

Advances in communications, multiprocessors, intelligence interfacing, and software, from projects now under development in the SDI Program, should greatly benefit U.S. fleet operations. For example, the SDI battle management software developed to track and intercept hundreds of ballistic missiles and reentry vehicles (RVs) should be readily adaptable to the Navy's requirements to perform similar operations involving seaborne and airborne friendly and hostile objects. Furthermore, SDI software development tools employing artificial intelligence and knowledge-based technology should markedly reduce the cost and time required to develop and manufacture secure and fault-tolerant software for tactical use in maritime operations.

The SDI advanced infrared sensor technology, if applied in naval aircraft and air defense missiles, could help fleet defenses keep pace with advances in the anti-ship missile (ASM) threat. Space-based radar, employing major advances in high-frequency and sophisticated signal processing techniques for extending sensor performance, will offer a valuable mix for confronting hostile forces with a multispectral surveillance, tracking, and targeting capability.

Spinoffs from HVG and laser technology could result in highly effective ship-based weapons for close-in defense. For example, a rapid-fire electromagnetic gun (rail gun) that propels a low-cost guided projectile could be very effective for defending against ASMs launched from bombers, ships, or submarines. Additionally, electromagnetic coil launchers, with the potential to launch much heavier aircraft from an aircraft carrier than currently is possible, offer a replacement for steam catapults.

Applications of SDI laser weapon technology could provide the quick-kill defense capability needed to counter even the most advanced ASMs. Advances in developing high-power microwave technologies for strategic defense may be applied to seaborne tactical weapons in defense against missiles and targeting satellites, and may be applied to suppression of enemy ship- and land-based defensive radars and command, control, and communications systems.

8.2.3 Ground Forces

For conventional ground force operations enemy forces may deploy a vast array of weapons, including tanks, mobile artillery, armored personnel carriers, and attack helicopters. These weapons are designed to provide the mobility and firepower necessary to defeat allied forces. To counter these capability, U.S. forces require a continued infusion of new technologies to provide improved capabilities in the areas of firepower, fire control, and command control, and communications, as well as improved power supplies to enhance the mobile operations of advanced weapons.

The SDI Program is developing a range of advanced technologies that could be used to develop advanced weapons, support systems, and control systems for conventional forces. For example, previous SDIO investment in HVG technologies could provide significant improvements in anti-armor operations. The HVG could be capable of long-range, rapid, lethal response to conventional attack. In addition, the ability to engage more than one target at a time is being developed through advances in computer-aided and controlled multi-target fire control systems. This ability would enhance the battle management functions of all forces and enhance their efficiency in the use of resources.

Relation Of SDI Technologies To Military Missions

The development of high-power-density power supplies could provide a significant benefit to the modern ground force, especially command and control and support elements. Improvements in power technology have led to the development of systems that can provide sufficient power with low noise and/or thermal signatures. Lightweight, quiet power systems would reduce the signature of critical units, thus enhancing survivability while meeting power needs.

The SDI Program also is developing technologies to automate the collection, fusion, and processing of massive amounts of intelligence data on a near-real-time basis. These technologies can help ensure the timeliness and availability of reliable intelligence required to support mobile forces on a battlefield.

8.2.4 Space Defense

U.S. space defense requirements include space surveillance and tracking, space defense weapons, and space system survivability. Particularly relevant are SDI systems (Brilliant Eyes, Brilliant Pebbles technology, Ground-Based Interceptor, Ground-Based Radar) and technologies for maneuvering and hardening space platforms.

Additionally, multi-spectral focal plane arrays and on-board processing are being developed to provide global coverage and multiple track file maintenance. Short-wavelength lasers have direct potential for tracking and providing rapid images of satellites.

8.3 Cost Effectiveness At The Margin

In past years, the focus of the SDI Program has been deterrence of a massive intentional Soviet missile strike. In the former U.S.-Soviet relationship, U.S. planners evaluated prospective defenses using the Nitze Criteria of military effectiveness, survivability, and cost effectiveness at the margin (CEATM).

Public Law 99-145, Section 222 (dated November 8, 1985) stated that "(B) the system is cost effective at the margin to the extent that the system is able to maintain its effectiveness against the offense at less cost than it would take to develop offensive countermeasures and proliferate ballistic missiles necessary to overcome it;..."

In the context of the previous U.S.-Soviet strategic balance, to prevent the Soviets from adding systems to overcome a deployed defense, the defense had to be less expensive to upgrade than the offensive weapons the Soviets deployed. In this context, the Soviets would have a reduced incentive to deploy extra systems, since the U.S. could counter these additions at less expense.

CEATM, while a key criterion for considering the possible deployment of a defense against a massive Soviet attack, is not relevant when applied to Global Protection Against Limited Strikes (GPALS). Additionally, the CEATM criterion was originally applied to avoid an unfavorable long-term, offense-defense, cost competition with the Soviet Union. Since a massive strike from the ex-Soviet, nuclear-capable republics is considered extremely unlikely, ensuring favorable CEATM is no longer an appropriate or relevant criteria.

Relation Of SDI Technologies To Military Missions

Nor is CEATM a useful criteria in the context of accidental or unauthorized launches from the former Soviet Union republics, or limited intentional strikes from other nations. The former Soviet Union has no incentive to modify its forces to ensure the success of accidental or unauthorized launches--this would be contradictory. And, with regard to intentional or other attacks by other nations, the defensive capabilities envisioned under the GPALS concept should be sufficient to handle the limited inventory of ballistic missiles these nations are likely to have in the near future.

A cost tradeoff more applicable to the mission of defending against limited strikes is the cost of the defense relative to the value of the protected assets. For a strike against the continental United States (CONUS), this means weighing the cost of GPALS against the value destroyed by an attack in the absence of a defense--potentially tens of millions of lives and hundreds of billions or trillions of dollars.

8.4 Survivability

A critical requirement of the Nitze criteria from Public Law 99-145 is to ensure the functional survivability of potential ballistic missile defense elements in a hostile environment. Public Law 99-145, section 222 states: "A strategic defense system development, test, and evaluation conducted on the Strategic Defense Initiative program may not be deployed in whole or in part unless - (1) the President determines and certifies to Congress in writing that - (A) the system is survivable (that is, the system is able to maintain a sufficient degree of effectiveness to fulfill its mission, even in the face of determined attacks against it)." The U.S.'s former principal concern was the possibility of defense suppression attacks by the Soviet Union on elements of a U.S. ballistic missile system. To address this concern, the SDI program pursued vigorous development of both passive and active survivability technologies, methods and tactics. Passive measures included: hardening the defensive systems against nuclear, kinetic energy, laser, and RF/microwave threats; redundancy; and autonomy. Active measures included options such as attack warning, on-board survivability management options, and evasion/deception tactics.

The defense suppression threat was an acknowledged critical factor in the design of defenses when the SDI program was focused on deterring and disrupting a massive Soviet attack. With the program focus changed to defense against a third country ballistic missile threat and protection against limited accidental or unauthorized attack by the former Soviet Union, it has been incorrectly assumed by some that the concern over a defense suppression attack can be completely relaxed. This position presupposes that defense suppression capability is currently beyond the technical and economic capability of most, if not all, of these countries. Additionally, a defense suppression attack has been viewed only as a precursor to a major Soviet attack. Since this major Soviet defense suppression threat was by far the most stressing, both SDIO threat definition efforts to define the threat and survivability efforts against it were formerly focused entirely in the Soviet direction.

However, an unauthorized limited attack by a 'rogue' commander or republic of the former Soviet Union could be accompanied by defense suppression measures if such an already existing capability was available to the commander or republic. Even without an accompanying defense suppression attack, the destruction by U.S. defenses of ballistic missiles and warheads in space may

Relation Of SDI Technologies To Military Missions

detonate the nuclear warhead(s) and produce a hostile (enhanced radiation and prompt nuclear) space environment in which remaining defensive systems would have to operate. In addition, modest defense suppression attacks by third countries are feasible, especially at the theater and tactical level. Therefore, the design of SDI systems and architectures, even under the GPALS concept, continues to incorporate survivability measures.

The survivability of potential ballistic missile defense systems is ensured through a two-fold approach. First, broad-based SDI survivability programs are maintained to support the development of all potential BMD systems. These efforts include:

- A Balanced Hardening Program, which develops survivability technologies such as: electronics that operate in hostile environments; hardened communications systems; and laser/radio frequency-jamming mitigation tactics. Once validated, these technologies are available for system developers to tailor them to satisfying system-unique requirements.
- An Environment/Analysis and Simulation program, wherein computer environment models are developed and made available to system developers. Operability demonstrations are conducted, and cost-effectiveness and functional assessments are performed.
- A special Theater Missile Defense survivability program which investigates theater-specific issues such as radar cross-section reduction techniques and protection from chemical/biological threats.
- A Test and Evaluation program, wherein proposed systems, subsystems, and components are subjected to simulated threat environments in test simulators, underground nuclear tests, and space flight tests.

Secondly, the formal DOD acquisition process demands that survivability requirements be developed and validated for each military system, and that adequate operational testing be conducted to ensure that systems satisfy those requirements before they are fielded. For SDI, survivability requirements are developed for both the individual defensive elements and for the overall defensive system. Operational testing or appropriate simulation is likewise required and will be conducted at both levels.

Appendix

Programs, Projects, And Activities Narrative Description And Status



PROJECT NUMBER: 1101
PROJECT TITLE: Passive Sensors
PROGRAM ELEMENTS: 0603215C Limited Defense System
0603214C Space-based Interceptors

PROJECT DESCRIPTION:

The project encompasses the research, development, testing and acquisition of visible through infrared sensor devices and systems required for the components comprising the Global Protection Against Limited Strikes (GPALS) systems. Specific research technologies include: radiation hardened silicone carbide and beryllium mirrors, visible through infrared detectors, detector read-out devices, on-array signal processing techniques, optical test facilities for characterizing and calibrating sensors, cryocooler development and life testing research of optical systems contamination in space, demonstrations of focal plane components, cost-performance-yield models for surveillance systems, and integrated advanced sensor demonstrations.

PROJECT NUMBER: 1102
PROJECT TITLE: Microwave Radar Technology
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

The over-arching goal of the Microwave Radar Technology Project is to develop an advanced radar technology base supporting the performance requirements of radar system elements in the Strategic and Theater Missile defense architectures. The objectives of this project are to provide the critical technologies in support of the lightweight, mobile and transportable requirements, the high volume, low cost component objectives and the system level performance goals of the Ground Based Radar. Technical challenges include waveform processing of high time-bandwidth products; extended system power, efficiency, bandwidth, polarization capabilities; improved reliability, availability and maintainability and thermal management; enhanced electronic counter, counter measures; and cost effective production methodologies. The major thrusts of the technology project currently under investigation include:

Solid state transmit and receive integrated circuit modules. Current technology is limited by the affordability of solid state distributed transmit/receive modules. Continued progress under this effort will achieve high volume production cost projections of several hundred dollars per module.

Advanced wide-band, high throughput radar signal processor, which will extend radar performance, improve Electronic Counter-Counter Measures and increase discrimination capabilities.

Fiber optic beam forming controllers, which offer potential to replace coaxial cable, stripline and waveguide manifolds. This effort will provide size, weight and costs savings and provide immunity to Electro-Magnetic Interference.

Appendix

PROJECT NUMBER: 1103
PROJECT TITLE: Laser Radar Technology
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

This project develops and demonstrates the laser radar technologies capable of supporting SDS components and architectures. Laser radar technology includes development of components, systems, data bases of target measurements and supporting analysis. Laser transmitters, receivers, mechanisms for steering and directing beams, and signal processing are included in component development. Data base development includes both laboratory and field measurements, and developing simulations for calculating laser radar cross sections and evaluating system performance.

For many missions, laser radars are preferred over microwave radars due to smaller size and tighter beam divergence. Laser radars can provide the high spatial and velocity resolution for midcourse discrimination of RVs from other objects and for designation and target localization as well. This technology will also be used in boost phase for active tracking of threat boosters and precision pointing of boost-phase weapons and terminal phase weapons, and in midcourse for designation. Specific technologies include lasers with high temporal and frequency stability and wide bandwidth waveforms, wide bandwidth detectors, optical beam steering and receiving systems for rapid retargeting, and signal processing and analytical tools required for implementation.

PROJECT NUMBER: 1104
PROJECT TITLE: Signal Processing
PROGRAM ELEMENT: 0603215C Limited Defense System
0603214C Space-Based Interceptors

PROJECT DESCRIPTION:

This project develops and demonstrates the techniques and components associated with on-board high speed sensor signal and data processing for multiple interceptor and surveillance sensor systems and provides a radiation hardened digital and analog circuit component technology base supporting LDS technologies. To accomplish mission objectives, key elements must perform large numbers of computations to perform surveillance, acquisition, tracking, and kill assessment of missiles and reentry vehicles. These elements must survive and continue to perform in high levels of natural and nuclear radiation. Selected elements must continue to operate through very high flash levels of nuclear burst. High speed and low power Very Large Scale Integrated (VLSI) electronic circuits and memories with performance comparable to DoD Very High Speed Integrated Circuit (VHSIC) technology must be developed to achieve very high levels of performance and radiation hardening. Further development of this technology is absolutely critical to lowering the risk and system costs involved with a deployment/full scale development decision. This project will produce: two radiation hardened state-of-the-art 32 bit Reduced Instruction Set Computers (RISC) for space applications; High speed radiation hardened analog to digital converters; Static and non volatile memory units; 16 bit space qualified computer subassemblies; and other linear and digital radiation hardened electronic devices as required. The RH32 processors and other microelectronics have special features that are required for space applications and are not found in

commercial products. For example, the level of testability, fault tolerance and radiation immunity built into the RH32 processors distinguish them from processors available or planned. The built-in fault tolerance features will enable the RH32 to operate through the harsh space radiation environment with a very high delivery of processor service. A companion effort, the RISC Ada Environment (RISCAE), will develop the software environment for both processor designs. Various elements of this effort are immediately available for system integration.

PROJECT NUMBER: 1105
PROGRAM TITLE: Discrimination
PROJECT ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

This task area is responsible for characterizing the optical and radar signatures of the threat objects (e.g. penails and RVs) and backgrounds for development of effective target acquisition and discrimination techniques for GPALS efforts related to systems funded under the Limited Defense System Program Element. Activities encompass all phases of ballistic flight. Collection and analysis is done on celestial and atmospheric backgrounds, development of phenomenology models, discrimination algorithms (Lexington Discrimination System (LDS)), and integrated tools for a realistic assessment of surveillance, acquisition, tracking, and discrimination techniques.

PROJECT NUMBER: 1106
PROJECT TITLE: Sensor Studies And Experiments
PROGRAM ELEMENT: 0603215C Limited Defense System
 0603217C Other Follow-On Systems
 0603216C Theater Missile Defense

PROJECT DESCRIPTION:

This project includes a variety of space and suborbital advanced technology demonstration experiments, studies, and support elements designed to integrate and assess newly-developed sensor technologies in as realistic an operational environment as possible before they are transferred to the GPALS system elements. These demonstrations of sensor technology coupled with advanced simulation technologies, will lead to comprehensive assessments of the technical feasibility, affordability, and operational utility of GPALS sensor and interceptor systems.

The Infrared Background Signature Survey (IBSS) provided multi-spectral (ultra violet, visible, and infrared) and radiometric measurements of orbiter plumes, earth backgrounds, chemical releases, orbiter environment, gas releases, and calibration sources. These data are critical to determining the requirements for the major SDIO systems. Measurements were made both with the Shuttle Pallet Satellite Platform (SPAS) II in the shuttle bay and with the SPAS deployed from the shuttle that has maneuvered from the immediate vicinity. The IBSS instrumentation package was developed jointly by the U.S. and MBB of the Federal Republic of Germany.

Appendix

The Shuttle Pallet Satellite (SPAS) III program will provide multi-spectral (ultra violet, visible and infrared) and radiometric measurements of liquid plume generator and orbital plumes, earth backgrounds, orbital environment and calibration sources. Mission operations onboard the Space Shuttle are planned for FY94. SPAS III is a follow-on mission to IBSS.

The Midcourse Space Experiment (MSX) will provide the system functional demonstration, target and background data, and the technology demonstrations necessary for the midcourse sensor platforms to meet Milestone II. MSX is planned for CY94. The principal sensor is a cryogenic MWIR/LWIR/VLWIR radiometer and spectrometer system with high off axis rejection optics. MSX will provide data on real midcourse targets against real backgrounds at realistic system ranges for use in system design trades and ground demonstrations; provide high quality target and background phenomenology data for further development of robust models of representative scenes; demonstrate key functions such as acquisition, tracking, handoff and bulk filtering; provide multi-wavelength target phenomenology data for assessing optical discrimination algorithms; and demonstrate the capability to integrate key technologies into a working platform similar to proposed operational midcourse sensor designs. The Midcourse Space Experiment (MSX) also relies on Advanced Electro-optics Technology funded under Theater Missile Defenses (PE No. 0603216C), which develops radiation-hardened visible and IR focal plane arrays and signal processing algorithms to be evaluated in experimental cameras.

Unconventional Passive Discrimination (UPD) is an evaluation and development task for optical discrimination techniques that make use of target signature time history information to perform target classification. Tests have been performed to investigate and quantify the interactions of an aerospace vehicle with the ambient space environment and implications to discrimination. The feasibility of these techniques and quantification was demonstrated with previous optical target observations and measurements (e.g., Malabar, Firebird, Have Jeep, Starmate, D180/181, DOT, HOE). The techniques are applicable to both surveillance and interceptor system elements.

The optical collection facility at Malabar, Florida performs observations of missiles and other targets within its detection range to support the development of Strategic Defense System elements. This is an ongoing measurements program.

The Red Tigress program consists of a series of sounding rocket launches to measure the radar and optical signatures of advanced penetration aids. Data collected during these launches will be used to validate discrimination algorithms for GPALS sensor and interceptor system elements.

PROJECT NUMBER: 1110
PROJECT TITLE: Sensor Integration
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

This program integrates some of the most advanced light-weight systems developed by SDIO as part of the Global Protection Against Limited Strikes (GPALS). The purpose of the sensor integration experiment is to fabricate integrated satellites with advanced sensors, computers, materi-

als and structures, electrical systems, and attitude control systems that can be tested in the deep space environment. The higher radiation dose of the deep space environment will be used to test the radiation hardness of the light-weight systems. The program is designed to develop, integrate, and test the components that are required in the space portion of the Limited Defense System program.

There are two deep space experiments planned in the sensor integration program. The first experiment usually referred to as Clementine-1 will be launched in early FY 1994 to demonstrate the use of the SDIO-developed light-weight technology in a mission around the Moon and a near-earth-asteroid (NEA). The second mission scheduled for late FY 1995 will flyby two NEAs. In the latter mission light-weight projectiles developed by SDIO will be used to strike the surface of these NEAs to determine the mineral configuration of the NEAs.

PROJECT NUMBER: 1201
PROJECT TITLE: Interceptor Component Technology
PROGRAM ELEMENT: 0603215C-Limited Defense System
0603217C-Other Follow-On Systems

PROJECT DESCRIPTION:

This project is developing advanced components for lightweight, low cost interceptors for global, national, and theatre missile defense. The technologies provide a basis for highly effective ground- and space-based interceptor systems that are deployable through the year 2000 and beyond, with follow-on efforts. Technology development efforts focus on addressing the more stringent requirements, such as on-board discrimination, greater kinematic capability, enhanced autonomy, and increased threat complexity. Component performance will be demonstrated through ground testing of hardware and software at contractor's facilities, the KKV Hardware-in-the-Loop Simulation (KHILS) facility, the National Hover Test Facility (NHTF), and through flight testing.

Funding reductions will make it necessary to cancel all of the work in this project in FY93, with the exception of the Pilotline Experiment Technology (PET) program. PET is developing producibility techniques for hardened LWIR HgCdTe focal plane arrays. Seeker components that were being developed ranged from the UV through the VLWIR. Early emphasis was placed on hardened focal plane array (FPA) and readout development (128x128 Pixels) and fabrication at low cost (1000 FPA/Year Production Rate) while maintaining required performance (11-14 μm Cutoff Wavelength). Recently initiated efforts in multicolor operation and neural network or optical processing techniques to aid in discrimination will all be terminated. A solid state ladar with an agile beam director is also being designed to provide robust discrimination capability.

The interceptor avionics technology development effort that produced a lightweight (75 g), high throughput (400 MOPS) signal and data processor that is programmable and very adaptable to a variety of interceptor applications will end. Hardening of this processor, development of neural networks for on-FPA signal processing, and creation of advanced algorithms for multi-seeker data fusion, image processing, discrimination, and autopilots will not occur.

Appendix

Inertial Measurement Unit (IMU) development focused on fiber optics and a lightweight (50 g), low cost (\$500/Unit) micromechanical inertial guidance system providing a 3-axis gyro and accelerometer on a single chip with performance parameters needed for homing guidance will be terminated. Programs initiated in 1991 to address the more stringent performance requirements associated with the longer flyout times of ground-based exo-and endo-atmospheric interceptors (0.01 - 1.0% Hour Drift Rate) will be cancelled. Development of a stellar navigation system has also been initiated to enhance lower grade IMU performance will also stop.

Propulsion system technology development, on-going since 1988, will all be terminated. Advanced liquid axial stage technology has been developed and tested that provides 8X weight reduction in stage weight over older interceptor propulsion systems while reducing cost. This particular component, known as ALAS, may be flight tested in the coming year onboard one of the LEAP experiments. Solid axial stage components have also been developed and will not be tested. These systems were primarily for space-based applications.

PROJECT NUMBER: 1202
PROJECT TITLE: EXO Integration Technology
PROGRAM ELEMENT: 0603215C Limited Defense System
0603217C Other Follow On Systems

PROJECT DESCRIPTION:

Funding provides for the development, independent government testing, and experimental integration of state-of-the-art component technology to provide risk reduction for systems that could be deployed prior to the beginning of the twenty-first century. The project includes further development of Lightweight Exo-Atmospheric Projectiles (LEAP) and their technologies and continued development of the Miniature Seeker Technology Integration (MSTI) program. Funding under this program also provides for continued LEAP flight testing at White Sands Missile Range and Atlantic Fleet Weapons Training Facility, development of advanced LEAP integrated technologies, and advanced LEAP test planning for potential weapon system applications. This project also supports planning for transition of the LEAP technologies into the Theater Missile Defense Program.

Develop, integrate and test low-cost, modular satellite bus utilizing VME architecture which will enable on-orbit demonstrations of advanced interceptor technology components. Bus will support simplified, rapid integration and testing of multiple technology payloads. Use the MSTI bus to perform orbital tests of interceptor seekers, processors, propulsion systems, communications systems, and other components in a long-duration space exposure environment which will provide performance data in support of interceptor EMD decisions. Also utilize MSTI satellites to collect optical phenomenology in multiple wavebands and performance information on LEAP flight tests, dedicated targets, and targets of opportunity. Incremental testing approach will be taken to eventually evolve a MSTI plume tracking, cueing, and handover capability which can be utilized on advanced LEAP interceptor flight tests.

PROJECT NUMBER: 1204
PROJECT TITLE: **Interceptor Studies And Analysis**
PROGRAM ELEMENT: 0603215C Limited Defense System
0603217C Other Follow-On Systems

PROJECT DESCRIPTION:

This project funds scientific, engineering, and technical support to government program managers in the interceptor technology directorate. Types of studies include special projects for advanced technologies, program planning and analysis, and aerodynamic studies and analysis. Additionally, trade studies are conducted to determine the best possible technologies in which to invest, in order to give the highest payoff to GPALS element interceptors.

PROJECT NUMBER: 1208
PROJECT TITLE: **Discriminating Interceptor**
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

To achieve a high probability of kill of midcourse targets, interceptors must be capable of discriminating between real targets, decoys and debris during the exo-atmospheric portion of flight. The interceptor must be lightweight, low cost, and must be able to kinematically engage a full range of threats. To acquire midcourse targets and perform discrimination at sufficient range to implement guidance commands requires broad utilization of the electromagnetic spectrum and use of ladar to capitalize on available discriminants. Processors must be able to support the large computational demand, while staying within cost and weight constraints. This was once beyond the limit of technology, but recent advances in interceptor signal and data processor development (Project 1201), have made a discriminating seeker and interceptor feasible.

Discriminating interceptors with increased autonomy will reduce communication bandwidths and simplify the overall architecture. Discriminating seekers are now feasible with higher resolution and signal-to-noise ratios than current state-of-the art technology can provide. Discrimination technology will allow interceptors to take advantage of not only temperature and emissivity, but of other discriminants as well, including spectral, temporal, and spatial characteristics.

The Advanced Discrimination Interceptor (ADI) program will design, fabricate, and test a technology test vehicle (TTV) traceable to an advanced vehicle concept (AVC) design, demonstrating technology for a block upgrade option for Ground Based Interceptor which are to be deployed at the initial NMD site. Seeker components will be developed that utilize the latest in active and passive technology to do discrimination on-board the interceptor. Critical components will be fabricated and tested. The TTV will be designed, fabricated, and tested to prove the technology. The program will culminate with the completion of a validated AVC design.

Appendix

PROJECT NUMBER: 1209
PROJECT TITLE: Endo-Atmospheric Interceptor Technologies
PROGRAM ELEMENT: 0603215C Limited Defense Systems

PROJECT DESCRIPTION:

The Endo-Atmospheric Interceptor Technologies Program is a comprehensive approach to coordinate the development and demonstration of advanced components critical for small, lightweight (<17kg) interceptors. These technologies will provide the basis for strategic and tactical ballistic missile interceptors operating within the atmosphere.

The project includes the development, evaluation and test of innovative active and passive seeker concepts and aperture concepts through Broad Agency Announcements (BAA). The BAA effort is managed for SDIO by the US Army Strategic and Space Defense Command, Huntsville, AL and the Naval Air Warfare Center, China Lake, CA. These seeker and aperture concepts will be tested in the Aero Optical Evaluation Center (AOEC) being developed by SDIO for this purpose.

Through the efforts of two prime contractors, using appropriate component technology from the BAAs and other sources, this project will develop and demonstrate miniaturized endoatmospheric interceptor testbed vehicles for strategic and tactical missile defense. The miniaturized experimental vehicle will have self-contained autonomous guidance, jet reaction or aerodynamic control, optical or radar seeker and will be capable of hit-to-kill (HTK) accuracy, not requiring a warhead.

The component technologies developed will provide block upgrade to current ERINT or Patriot concepts, enhanced THAAD performance capabilities, and enabling technologies for CORPS SAM and Navy TMD. Aimpoint selection and minimum seeker response time will provide assured endoatmospheric Hit-to-Kill performance, making the interceptor more responsive to advanced threats. RF technologies will replace current TWT technologies with high power solid state devices, significantly reducing interceptor size and weight.

This project will provide endoatmospheric technologies for the Ground Based Interceptors which are to be deployed at the initial NMD site. The aero-thermal and aero-optical issues associated with hyper velocity flight in the atmosphere will be resolved. Advanced window materials and cooling techniques will be developed and tested. This will provide interceptor velocities and performances that incorporate and exceed the current low velocity interceptor flight capability, and make the concept of E2I feasible.

PROJECT NUMBER: 1212
PROJECT TITLE: D-2 Program
PROGRAM ELEMENT: 0603217C Other Follow-On Systems

PROJECT DESCRIPTION:

This project was to demonstrate the launch of a guided projectile (D-2) from a hypervelocity gun (HVG) with associated fire control to demonstrate the potential of a HVG system as a candidate

weapon system for Theater Missile Defense (TMD) in the near term and other longer range applications in the far term. This involves the development of the Gee-hardened D-2 projectile which is a command guided to terminal homing interceptor.

PROJECT NUMBER: 1301
PROJECT TITLE: Radio Frequency Free Electron Laser (RFFEL) Technology
PROGRAM ELEMENT: 0603217C Other Follow-On Systems

PROJECT DESCRIPTION:

The goal of the RFFEL program is to demonstrate the capability of a high power FEL to perform boost phase and post-boost phase intercept of ballistic missiles or theater missiles from earth orbiting platforms. Midcourse interactive discrimination is also possible by destroying simple decoys and thermally tagging or imparting velocity change to sophisticated decoys. Additional Space Based (SB) FEL missions include self defense, defense of other platforms in the strategic defense constellation, and the suppression of tactical aircraft.

The primary thrust of the current program is the design and fabrication of a proof-of-principle FEL device to validate FEL technology and prove high power scaling capability to BMD weapon requirements. This effort is called the Average Power Laser Experiment (APLE). The APLE is a tunable (9-11 micrometer) 100kW average power FEL utilizing a Single Accelerator Master Oscillator-Power Amplifier (SAMOPA) design.

SBFEL technology development is planned in parallel with the APLE device fabrication, concentrating on advancing and tailoring FEL technology required for operation in a space environment. This technology includes improved system efficiency, and the development of superconducting and cryogenic accelerators. The technology development strategy leverages a large amount of beam control, optics and acquisition, tracking, pointing, and power technologies from other directed energy weapon projects.

PROJECT NUMBER: 1302
PROJECT TITLE: Chemical Laser Technology
PROGRAM ELEMENT: 0603217C Other Follow-On Systems

PROJECT DESCRIPTION:

The Chemical Laser program is developing critical technologies applicable to ground-, air-, and space-based high energy laser (HEL) systems. One application of this technology, space-based chemical lasers (SBLs), can provide global (to the cloud tops), 24 hour, zero time-to-intercept hard kill of strategic and tactical targets. This capability adds early boost phase kill of strategic and tactical ballistic missiles, increased capability for hard kill in the bus phase, additional robust passive and active midcourse discrimination against simple decoys, interactive discrimination against more sophisticated decoys, and negation of long range strategic bombers and cruise missiles. Early boost phase kill of strategic or tactical ballistic missiles provides very high leverage to the defense by negating missiles before they can deploy multiple warheads, decoys, chemicals,

Appendix

or submunitions. In all cases, debris will fall far from protected territory and, in many cases, on the territory of the aggressor. Early boost phase kill also provides effective defense against threats which are most difficult for conventional architectures, namely low apogee trajectory and high traffic threats.

The current emphasis in the Chemical Laser program is ground-based research aimed at critical technical issue resolution of this high payoff technology. Critical technical issues for a chemical laser weapon system can be grouped into five areas: the laser device; beam control; optics; acquisition, tracking, pointing and fire control (ATP/FC); and high power integration. The laser or beam generating device is a hydrogen fluoride chemical laser which produces the high power laser beam by photon extraction from excited HF molecules, generated by the energetic reaction of hydrogen and fluorine. In multiple tests from 1990 to 1992, the Alpha HF laser demonstrated near-weapon-level continuous-wave operation. The Alpha design is space compatible and directly scalable to weapon-level power requirements. Required beam control technology was demonstrated by the LODE program in 1987. Required optical technology can be subdivided into two classes: small high-incident-power optics for handling the high power beam within the HEL and large moderate-incident-power optics for directing the expanded high power beam toward the target. Required small high-power optics have been demonstrated in a number of chemical laser programs, including Alpha. The LAMP program, completed in 1989, demonstrated a 4-meter diameter beam director primary mirror whose design is space compatible and directly scalable to weapon size. ATP/FC technology is being developed in project 1305 and has made excellent progress toward developing the technology to meet HEL ATP/FC requirements. High power integration is being demonstrated on the ground through the Alpha & LAMP Integration (ALI) program. In ALI, the Alpha, LODE, and LAMP hardware and technologies are being integrated for an end-to-end (save ATP/FC) ground demonstration of an HEL in FY96. Following ALI chemical laser technology will be ready for demonstration in space. Star LITE, a conceptual design for such a demonstration, was completed in FY92.

In parallel, a number of laboratory efforts are developing additional promising technologies for defense against robust far-term threats. These efforts include low absorptance optical coatings that may permit the use of uncooled optics throughout the optical train, shorter wavelength lasers that may achieve equivalent range performance with a smaller diameter beam director mirror and penetration of the atmosphere to lower altitude, molecular (rather than mechanical) methods for compensation of beam aberrations to produce the required beam quality, optical train designs that would permit retargeting over larger angles by tilting a lightweight, small-diameter mirror rather than pointing the entire telescope, and manufacturing techniques for improving the producibility and decreasing the cost of large optics.

PROJECT NUMBER: 1303
PROJECT TITLE: Neutral Particle Beam Technology
PROGRAM ELEMENT: 0603217C Other Follow-On Systems

PROJECT DESCRIPTION:

The Neutral Particle Beam (NPB) project exploits the capability of a stream of atomic particles to penetrate into a target 1) to provide lethal energies and/or 2) to induce signatures that permit discrimination. Such a beam is capable of effecting kill of ballistic missiles in the boost, post-boost,

and midcourse phases. The NPB project has a technology development segment, a ground-based technology integration segment, and a space experiments segment. Together, these segments address the key technical and system issues associated with the feasibility of deploying an NPB system capable of lethal intercept as well as midcourse discrimination. The technology development segment concentrates on developing enabling technologies for the ground and space experiments and initially deployable NPB systems. In the ground-based integration experiments, the Accelerator Test Stand (ATS) was used to integrate and test low energy components; the Ground Test Accelerator (GTA) is the primary test bed for initial NPB system development and also for advanced technologies such as high brightness ion sources, advanced neutralizer development, and Acquisition, Tracking, Pointing and Fire Control (ATP/FC); and the Continuous Wave Deuterium Demonstrator (CWDD) examines high duty factor and deuterium operation at low energies. The NPB space experiments addressing key issues not possible to resolve on the ground include Beam Experiments Aboard a Rocket (BEAR, flown in July 1989), which addressed basic space operability questions, and an orbital NPB space experiment (NPBSE), which will demonstrate integrated performance against a distant target using innovative approaches to lower cost and enhanced performance.

PROJECT NUMBER: 1305
PROJECT TITLE: Acquisition, Tracking, Pointing and Fire Control Technology
PROGRAM ELEMENT: 0603217C Other Follow-On Systems

PROJECT DESCRIPTION:

Acquisition, tracking, pointing and fire control (ATP/FC) efforts will advance the technologies required to perform critical functions for candidate DEW and some BPI concepts to be used in GPALS follow-on architectures. These functions include acquiring, identifying, and prioritizing the targets to be engaged, precision tracking of each target, selecting and establishing the line-of-sight to the target aimpoint, holding the beam on the aimpoint, assessing the results, and reinitiating the sequence to engage a new target. ATP/FC technologies are required for both boost-phase destruction and midcourse interactive discrimination missions. Efforts within the ATP/FC technology base address major tracking/pointing component performance issues, and the development of technologies for advanced ATP/FC experiments through the Advanced DEW Active Precision Tracker (ADAPT) program. Studies to define experiments that integrate ATP/FC with weapon concept experiments in both the space-based laser and NPB projects have been completed. A series of field experiments with payloads on high altitude balloon platforms will obtain critically needed phenomenology data and build upon technology base products to demonstrate all the tracking and functional integration needed to control single target engagements.

PROJECT NUMBER: 1307
PROJECT TITLE: DE Demonstrations
PROGRAM ELEMENT: 0603217C Other Follow-On Systems

PROJECT DESCRIPTION:

The Aircraft Based Laser (ABL) is a directed energy weapon concept for theater missile defense. The speed of light capability of the laser weapon may allow the ABL to destroy theater missiles

Appendix

during boost phase at long range, providing a boost phase defense layer that does not require overflight of enemy territory. Destroying theater missiles during boost phase provides many advantages. The missile is most vulnerable during this phase of flight. It is easy to detect and track the plume from the burning rocket engine. Experiments, analysis, and technology development leading to the demonstration of the airborne laser concept are performed.

A second objective is to develop and validate technologies to enable compact, lightweight and efficient high average power solid-state lasers.

PROJECT NUMBER: 1403
PROJECT TITLE: Computer Engineering
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

This effort provides technologies required to develop a highly reliable space borne multiprocessor computer architecture. This project consists of two technology tasks: An Advanced Information Processing System (AIPS) which develops an operating system able to meet reliability requirements; and a Very High Speed Integrated Circuit (VHSIC) multiprocessor development effort. The project concentrates on efficient, reliable methods of connecting modern processors into a multi-processor configuration. The tasks result in a technology base and a demonstration of highly reliable, multiple computer configurations.

PROJECT NUMBER: 1405
PROJECT TITLE: Communications Engineering
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

This project develops communications technology to support operational requirements for defensive systems. The project concentrates on communications component, development and demonstration. The primary focus is on radio-frequency (RF) components for space-to-space, space-to-ground, and ground-to-space links. Some advanced technology work in high power laser diodes, receivers, and pointing and tracking systems is included. Definition of requirements for space qualification and radiation hardness of extremely high frequency (EHF) components needed for robust communications is included.

PROJECT NUMBER: 1501
PROJECT TITLE: Survivability Technology And Demonstration Project
PROGRAM ELEMENT: 0603215C Limited Defense System
0603216C Theater Missile Defense

PROJECT DESCRIPTION:

A Public Law (99-145) and National Security Directive (14) dictate that Strategic Defense Systems must be survivable, and DoD Instruction 5000.2 requires that survivability of the system be discussed at each DAB Milestone and adds that, as early as practicable, developers and test agencies must validate critical survivability characteristics. This project's objective is to demonstrate that survivability technologies are in hand and that the National Missile Defense (NMD) elements can be demonstrated to be survivable (able to perform their missions in all expected environments) prior to Milestone II. To achieve this objective, the project uses a combination of approaches: weapons effects testing (to include underground nuclear testing, when available), operability demonstrations, studies and analyses, development of survivability enhancement technologies, and concurrent survivability engineering. Concurrent survivability engineering involves working directly with the NMD element program offices and prime contractors to ensure that survivability considerations, including the latest technologies and test results, are included at each stage of the design process.

PROJECT NUMBER: 1502
PROJECT TITLE: Lethality and Target Hardening
PROGRAM ELEMENT: 0603215C Limited Defense System
0603217C Other Follow-On Systems
0603214C Space-based Interceptors
0603216C Theater Missile Defense

PROJECT DESCRIPTION:

The Lethality of SDI weapons is part of the measure of effectiveness of how well proposed strategic defense weapon system concepts can fulfill mission requirements. The Lethality and Target Hardening program is developing a necessary and sufficient understanding of physical principles involved in defensive weapon/target interaction, target response and kill modes, and resulting signatures for discrimination and damage assessment. Strategic threats addressed include boosters, post-boost vehicles (PBVs), and reentry vehicles (RVs) from the threat intercontinental ballistic missiles (ICBMs) and submarine launched ballistic missiles (SLBMs).

The Lethality task funded by PE 0603215C provides supporting lethality technology for developmental SDI National Missile Defense (NMD) weapon concepts. This technology program includes lethality phenomenology analyses and tests to evaluate ground-based kinetic energy weapon (KEW) concepts that potentially use hit-to-kill (via body-to-body impact) or non-nuclear enhancement devices (e.g., fragmenting warheads, rods, or other forms of distributed mass) to destroy strategic threats. The terminal defense threats addressed are individual RVs and some SLBM PBVs.

Appendix

The Lethality task funded by PE 0605217C provides supporting lethality technology for developmental SDI directed energy weapons. This supporting lethality technology includes lethality phenomenology analyses and tests to evaluate thermal laser and neutral particle beam weapon effectiveness against simulated threats. Priority technology support addresses thermal laser lethality issues in the low irradiance (Lo I) regime applicable to nearer term laser weapons.

Finally, the Lethality effort funded by PE 0605214C provides supporting lethality technology for developmental SDI Global Missile Defense (GMD) weapon concepts. This technology program includes lethality phenomenology analyses and tests to evaluate space-based KEW concepts (e.g., Brilliant Pebbles) that potentially use hit-to-kill (via body-to-body impact) to destroy individual threat RVs or to engage threat PBVs (from either ICBMs or SLBMs) carrying one or more RVs.

For each of these tasks, the Lethality and Target Hardening technology program conducts laboratory and ground-based tests to understand the phenomenology involved. The lethality program also participates in flight test programs to verify that systems meet appropriate kill effectiveness requirements.

PROJECT NUMBER: 1503
PROJECT TITLE: Power and Power Conditioning
PROGRAM ELEMENT: 0603217C Other Follow-On Systems
0603218C Research & Support Activities

PROJECT DESCRIPTION:

This program was established to develop generation and conditioning technologies capable of producing required quantities of electrical power needed for advanced ground- and space- based kinetic/directed energy weapons and surveillance and BM/C³ systems. Power requirements for the various payloads are divided into two broad categories: (1) continuous power for surveillance, communication and housekeeping applications; (2) short-term power for interceptors and discrimination operations. The major projects in the PE to satisfy program requirements include: TMD-GBR Generator, Advanced Battery, Thermionic Fuel Element, Advanced Solar Power Technology, Thermionic System Engineering Test (TSET), Tacitron, 40 kWe Thermionic Reactor, and NEP Space Test, which will demonstrate compatibility of power technology with its client (propulsion testing) technologies.

PROJECT NUMBER: 1504
PROJECT TITLE: Materials and Structures
PROGRAM ELEMENT: 0603215C Limited Defense System
0603217C Other Follow-On Systems
0603214C Space-Based Interceptors
0603218C Research And Support Activities

PROJECT DESCRIPTION:

The Materials and Structures (M&S) Project conducts research, development and flight and

ground test demonstrations in lightweight structural materials, adaptive structures technology, propulsion/thermal/optical materials, tribomaterials, superconductor devices, and space environmental effects.

Limited Defense System

M&S supports Sensors and Interceptor activities through the application of advanced materials technologies to element designs and orbital flight tests of advanced materials. These efforts will provide for medium earth orbit exposure of potential material samples, avionics and sensor components to the natural space environment. M&S technology will also be used to reduce vibration through the application of improved adaptive structures and passive damping materials. M&S will develop ultrastiff lightweight interceptor and satellite structural components for system level tests and validation. Absorptive baffles will be fabricated for tests to verify threat robust technology advancements.

Research and Support

Research and Support M&S projects focus on providing advance materials and structures technology demonstrations to meet the extreme pointing and tracking, secure communications and enhanced discrimination requirements of near and far term GPALS systems as they mature in development. To gain confidence in the ability of these systems to operate in the natural and threat environments requires system selected materials evaluations and adaptive structure technologies. Superconducting devices will provide orders of magnitude increased capabilities in secure communications and target discrimination. M&S will continue the evaluation of the optical properties of diamond films supplied by US and foreign vendors for robust IR transmissive optics.

Other Follow-on Systems

M&S supports the development of adaptive structures for space based system applications including lightweight solar array drives and sensor vibration control. These advances enhance target acquisition, tracking, and discrimination performance of space systems. M&S will continue the low earth orbit active and passive evaluation of candidate space durable materials supplied by prime contractors and form the technology programs.

PROJECT NUMBER: 1601
PROJECT TITLE: Innovative Science And Technology (IST)
PROGRAM ELEMENT: 0603218C Research And Support Activities

PROJECT DESCRIPTION:

Innovative Science and Technology (IST) programs give SDI a chance to use tomorrow's technology sooner. It invests seed money in high-risk technologies that could dramatically change how SDI develops. IST causes and exploits breakthroughs in science to keep SDI at the foremost edge of what is possible for ballistic missile defense.

IST seeks out the novel and the innovative to catalyze revolutionary, not evolutionary, changes in SDI systems capabilities. IST sponsors a balanced mix of projects with both near term and far term payoffs, and provides funding from basic research through to early engineering prototype.

Appendix

IST oversees forty experts in the DoD and NASA. They find the world's best technologists willing to pursue new ideas in technology for SDI. About 600 contracts, half at universities, are active. IST is SDI's link to the top research universities and to the future engineers and scientists who will build the strategic defense system.

PROJECT NUMBER: 1602
PROJECT TITLE: New Concepts Development
PROGRAM ELEMENT: 0603218C Research And Support Activities
0603216C Theater Missile Defense

PROJECT DESCRIPTION:

This program explores innovative concepts pursuant to PL102-564 that mandates a two-phase R&S competition for small businesses with innovative technologies.

Projects are selected in a two-phase competition on three criteria: degree of innovation, help to SDI, and future market potential. Phase 1 awards typically \$50,000 to show feasibility of a new technology concept. Phase 2, open only to Phase 1 winners, awards typically \$500,000 to develop a prototype. In addition to a project's merit as a useful SDI technology advance, it is also judged on its potential for commercialization as directed by PL102-564. Congress re-authorized the mandatory set-aside program in 1992 to extend through 1999.

PROJECT NUMBER: 1701
PROJECT TITLE: Launch Services
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

Provide experienced launch and flight test teams including: launch vehicle procurement; launch services; payload processing; payload integration; mission operations/planning; range operations/integration; mission analysis; and test operations for technology development and research programs in support of options for the possible deployment of a Limited Defense System.

PROJECT NUMBER: 1702
PROJECT TITLE: Special Test Activities
PROGRAM ELEMENT: 0603217C Other Follow-On Systems

PROGRAM DESCRIPTION:

Develop accelerated test programs for emerging special application technologies. Determine acquisition strategy. Acquire test systems and test equipment. Plan and execute test programs including on-orbit command, control, and validation of demonstration payloads and resulting data collection.

The Single Stage Rocket Technology Program (SSRTP), is being accomplished under this effort. The SSRTP will focus on the development of technology for a reusable, suborbital launch vehicle. The SSRTP program will design, develop, and validate a reusable launch vehicle capable of air-line-like operations to augment space launch capability.

PROJECT NUMBER: 1703
PROJECT TITLE: TechSat
PROGRAM ELEMENT: 0603217C Other Follow-On Systems

PROJECT DESCRIPTION:

The TechSat project provides for the planning and execution of a coordinated and cost-effective space flight test program for the SDIO Technology Directorate (TN). The project will develop a family of small satellite buses and utilize compatible launch vehicles provided by other TN programs to meet the broad objectives of frequent and affordable space flight launches to validate technologies for advanced capability SDIO space assets. TechSat launches will carry technology experiments to orbits of interest to SDI. The flight experiment hardware to be carried into space will be drawn from the full breadth of the TN technology base.

The TechSat project provides for resources to plan, assess, and implement a coordinated TN space flight test program. The project will assess and establish satellite and launch vehicle design specifications and the production rates, standardize flight experiment satellite services, establish a coordinated space flight test plan and set experiment flight priorities, fund the development of low cost lightweight satellite buses, assign flight experiment hardware, satellite and launch vehicle for each mission launch, provide for all hardware integration services in support of a launch schedule, and manage flight and ground operations. The project provides funding through agents for the integration of flight hardware for each launch.

PROJECT NUMBER: 2102
PROJECT TITLE: Space-Based Sensor (Brilliant Eyes)
PROGRAM ELEMENT: 0603215C Limited Defense System
0603216C Theater Missile Defense

PROJECT DESCRIPTION:

The Brilliant Eyes (BE) system is a distributed constellation of low earth orbiting space based surveillance satellites that support GPALS Battle Management/Command, Control, and Communication, National Missile Defense (NMD), and Theater Missile Defense (TMD) ground sensors and weapons systems. In addition, the BE system provides data on threat development, deployment, and testing. The data is used for sensor system optimization and block upgrade development for ballistic missile defense systems.

A constellation of BE satellites provides global (below-the-horizon and above-the-horizon) access of tactical and strategic ballistic missiles in their boost, post boost, and midcourse phases in response to directed tasking from the Command and Control Element. The BE element provides

Appendix

a capability to monitor missile launch locations within designated regions for early booster tracking or may be used as a launch confirmation source during the boost phase on a global basis.

BE satellites carry a suite of passive sensors including short-, medium-, and long-wavelength infrared and visible sensors. These sensors acquire and track strategic and longer range tactical ballistic missiles in the boost phase and continue to track and discriminate the reentry vehicles from debris and penetration aids throughout the midcourse flight of the missiles. The satellites are in low earth orbits which afford relatively short ranges to the missiles compared to geosynchronous satellites. These shorter ranges allow the BE sensors to detect smaller missiles and provide more accurate trajectory estimates throughout the missile's trajectory. The BE constellation is sized to provide global access to any theater worldwide on a moments notice. BE can either be cued by an early warning sensor such as DSP or FEWS or can be actively monitoring areas of interest in anticipation of missile launches.

The BE element is being developed on a schedule which permits deployment soon after the initial NMD site is operational. The BE support to Ground Based Interceptors (GBI) provides the maximum time for the GBI flyout, generating the maximum possible defended footprint from each GBI site. The BE element also provides support to theater defenses by cuing the radars and providing data for committing Theater High Altitude Area Defense (THAAD) and Navy interceptors. Against longer range theater ballistic missile threats, this increases the defended footprint area by a factor of 10 from that provided by local radar support alone, greatly decreasing the ground assets required in theater for a given level of defense. BE missile track data also supports the passive and counterforce pillars of TMD. BE also is capable of peacetime monitoring of missile flights worldwide, providing important signature data to allow defenses to maintain their effectiveness as new threats appear.

The major technical issues being addressed by this program include: (1) software validation and performance utilizing SDIO test beds (Surveillance Testbed and National Testbed); (2) distributed surveillance, sensor fusion, and sensor taskings utilizing computer simulations and flight demonstrations; (3) sensor acquisition, tracking, and discrimination performance with simulated and actual backgrounds utilizing ground and flight demonstrations; (4) technology maturity and performance through analyses, hardware in the loop ground tests, and flight demonstrations; (5) weapon support capacity and loading utilizing analyses and hardware-in-the-loop ground tests; and (6) producibility demonstrations utilizing analogy to current systems and engineering models and simulation of critical components.

The test program for BE includes computer simulations, ground demonstrations, and flight demonstrations to collect data and demonstrate the technical maturity of the BE program for a Milestone II decision in late 1990s. Technology maturity can support an early 2000s BE deployment.

BE funding includes work being performed to develop SDIO sensor test capabilities at Arnold Engineering Development Center (AEDC). Two existing sensor test chambers at AEDC are being upgraded, the 7V chamber and the 10V chamber. The 7V chamber will be used principally for seeker testing (such as GBI, THAAD, and Brilliant Pebbles), and for calibration of surveillance sensors (such as BE). The 10V chamber will be used to perform end-to-end functional and

performance characterization and testing of surveillance sensors. These ground test capabilities are required for BE, as well as providing support for other SDIO programs.

PROJECT NUMBER: 2103
PROJECT TITLE: Ground-based Surveillance And Tracking System
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

The primary role of the Ground-based Surveillance and Tracking System (GSTS) was to be a launch-on-demand surveillance, acquisition, and tracking and discrimination system to provide interim target cuing in support of interceptor engagements from the first National Missile Defense (NMD) site until the Brilliant Eyes (BE) system became available. The GSTS system was to be composed of ground equipment and a launchable, long wavelength infrared (LWIR) sensor system. The sensor system would have been boosted into suborbital flight by a ground-based, fast response rocket to provide above-the-horizon surveillance to detect and track attacking ballistic missiles during the midcourse (ballistic) phase of their trajectory. The system is operational only when activated and its useful life is very limited in any extended attack.

Based upon the U.S. Space Command operational concepts, cost comparison, and coverage, BE was selected to provide tracking and discrimination to the Ground-based Interceptor (GBI). GSTS was then considered as an option for interim cuing of GBI at the initial site, prior to deployment of BE. In this case again an alternative source, Early Warning Radars (EWRs), was found to be cheaper and have better coverage than GSTS. Therefore, in the interim cuing of GBI will be done by upgrades of the EWRs. With the Congressional direction to delay the deployment date for National Defenses until 2002, the requirement for the interim cuing capability is greatly reduced because the primary system -- Brilliant Eyes -- will be nearly operational around that time. Therefore, GSTS is no longer required to support NMD.

FY 1993 funding shortfalls and Congressional deferral of the initial site deployment date to 2002 has necessitate that SDIO terminate the GSTS program option. The termination is being handled by the contracting and acquisition management office of the U.S. Army Space and Strategic Defense Command. Termination costs for the project are estimated to be no more than \$10.5 million.

PROJECT NUMBER: 2104
PROJECT TITLE: Ground-Based Radar
PROGRAM ELEMENT: 0603215C Limited Defense System
0603216C Theater Missile Defense

PROJECT DESCRIPTION:

The TMD-GBR is the theater radar supporting the Upper Tier Theater Missile Defense System (UTTMDS). The NMD-GBR is the strategic radar of the initial deployment complying with the National Missile Defense Act of 1991 and of the eventual full Global Protection Against Limited

Appendix

Strikes System (GPALS) deployment. Both radars are similarly designed sharing co-development, co-production, and life-cycle cost savings. The NMD-GBR has a bigger antenna, more modules and require a larger power supply than the TMD-GBR. These two systems are being procured as the strategic and theater members of the SDIO "Family of Radars."

National Missile Defense Ground Based Radar (NMD-GBR)

The NMD-GBR is required to detect, acquire and track RVs from accidental or unauthorized limited strikes from ICBMs, SLBMs or MRBMs. The NMD-GBR provides support data to the Command and Control Element which combines data from all available sensors to the Ground Based Interceptor (GBI) in exoatmospheric engagements. The NMD-GBR can operate autonomously or can use range extending cueing support from other space and/or ground based sensors. The NMD-GBR provides data to support weapon target assignment (WTA), sensor fusion, kill assessment, and employment option support. The NMD-GBR will also provide data to support precision tracking, launch point prediction and signal/data processing for exoatmospheric discrimination and classification in support of the Ground Based Interceptor (GBI). The GBR-T Dem/Val radar will provide the Functional Test Validation (FTV) of the NMD-GBR at the USAKA national range.

Family of Radars Design Concept

The design and fabrication of the TMD-GBR and the NMD-GBR will be based upon the family of modular X-Band radars concept derived from the GBR-X radar program conducted 1986-1991. The transmitter (power) and aperture are sized to the radar tactical range requirements. The radar transmitting technology for the TMD-GBR Dem/Val radars is solid state transceiver modules and the NMD-GBR Dem/Val radars use traveling wave tubes with ferrite phase shifters. Significant commonality exists between the TMD-GBR Dem/Val radars and the NMD-GBR Dem/Val radars in the areas of the radar receivers, signal processors, data processors, recorder subsystems, beam steering generation, and software. Issues concerning higher power rated solid state transceiver modules needed for EMD will be resolved by a parallel Solid State Demonstration Array contractual effort.

A key GBR issue is producibility and availability. Early coordination between the prime contractor and the SDIO producibility and manufacturing program will ensure that producibility goals are met. The ability to meet these goals will be demonstrated through competent ground testing.

PROJECT NUMBER: 2202
PROJECT TITLE: Ground-based Exoatmospheric Interceptor Development
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

The objective of the Ground-Based Interceptor (GBI) development effort is to develop and deploy a ground-launched exoatmospheric interceptor designed for hit-to-kill (non-nuclear) intercepts of Intercontinental Ballistic Missile (ICBM) and Submarine-Launched Ballistic Missile reentry vehicles (RVs) in the midcourse of their trajectories. Midcourse sensors will acquire, track, and pass threat cluster information to the Command and Control Element, which will cue the interceptors and provide updates if they are available. Using on-board sensors, the interceptors will

acquire the threat cluster and select the RV, and kinetically destroy it.

The GBI was selected as the interceptor for an initial site deployment because of the advanced state of GBI technology and testing. The testing included the successful Exoatmospheric Reentry vehicle Interceptor Subsystem (ERIS) program. The NMD GBI effort began in FY 1992 with a competition which resulted in the award of three Development Options Assessment contracts. The earlier GBI Dem/Val effort has been rescoped to reduce risk by pursuing critical interceptor component development until award of the National Missile Defense (NMD) GBI contract. A request for proposals was released 20 November 1992 for the NMD GBI development.

The NMD GBI Dem/Val contract will be awarded in 3Q/FY93 to a single prime contractor. The prime will use appropriate technology to develop a prototype interceptor for demonstrating GBI capability. The DEM/VAL NMD GBI may be fielded in a User Operational Evaluation System if the Government directs. Depending upon threat changes and technology developments, the final production version of the NMD GBI may incorporate an endoatmospheric kill vehicle (KV) or a more advanced exo KV as a Pre-planned Product Improvement (P3I) after Milestone II. SDIO technology is performing the upgrade research.

Key GBI issues include producibility and reliability, availability, and maintainability (RAM). Early coordination between the prime and the SDIO producibility and manufacturing program will ensure that producibility goals are met. The ability to meet RAM goals will be demonstrated through component ground testing, along with stockpile testing of nontactical interceptors. The interceptor will be designed to achieve its effectiveness goals as part of a ballistic missile defense system. Simulation, ground (hardware-in-the-loop) testing, and flight testing will be used to demonstrate interceptor capability. Simulation and appropriate testing will demonstrate capability and survivability against different threats.

PROJECT NUMBER: 2205
PROJECT TITLE: Brilliant Pebbles Interceptors
PROGRAM ELEMENT: 0603214C Spaced-Based Interceptors

PROJECT DESCRIPTION:

The Space-Based Interceptor (SBI) Program Element (PE) is a research effort to develop promising follow-on anti-ballistic missile technologies. Project 2205 within this PE funds the Brilliant Pebbles (BP) program. BP is an element of the Global Missile Defense (GMD) program, which in turn, is one segment of the Global Protection Against Limited Strikes (GPALS) ballistic missile defense system. The BP program is directed toward demonstrating and validating a system concept that defeats both theater and strategic ballistic missiles with ranges greater than approximately 500 kilometers in normal flight trajectory--or about 800 km for depressed trajectories, whatever their source or destination on the globe, in their boost, postboost, and midcourse phases of flight. The product of the BP program will be a Brilliant Pebbles system that consists of space, ground, and launch components. The space component is comprised of singlet interceptors and their associated "life jacket" carrier vehicles. The interceptor is a light-weight, kinetic, hit-to-kill vehicle that incorporates sensors, guidance control, battle management, and an axial propulsion stage. It possesses high-rate attitude control, on-board data processing, navigation, and

Appendix

divert propulsion capabilities. Each life jacket provides on-orbit power, low-rate attitude control, surveillance, communication, thermal control, navigation, and survivability. The ground component provides "man-in-the-loop", positive control of the BP constellation. The launch component is used to place the deployment package of BP singlets into space and operational orbits.

The objectives of the current BP Pre-EMD phase include: finalizing the BP System Concept, demonstrating and validating the system design concept; developing and implementing a comprehensive risk management/mitigation program; and conducting the necessary trade-offs to balance performance, producibility, operability, supportability, affordability and schedule requirements. Specific technical issues to be resolved during Pre-EMD include demonstrating: target acquisition, discrimination and tracking; BP end-game intercept performance and flyout guidance performance; station keeping adequacy; singlet and life jacket performance; communication systems; computers and software; survivability; launch system/payload integration; and linkages with the element command center. These demonstrations will be performed through a combination of: Treaty compliant orbital and suborbital flight testing; ground and underground testing; hover tests; "hardware-in-the-loop" testing; detailed simulations; and technical analyses. Overall risk assessment for Pre-EMD is low to moderate.

The BP concept evolved from key component technology efforts conducted by Lawrence Livermore National Laboratory (LLNL). These results were passed to industry for technical advancement and testing. LLNL will continue to provide advice to both the industry contractors and the government task force.

PROJECT NUMBER: 2300
PROJECT TITLE: Command Center
PROGRAM ELEMENT: 0603215C Limited Defense System
0603216C Theater Missile Defense

PROJECT DESCRIPTION:

The Command and Control Element (C²E) will develop the Battle Management, Command, Control, and Communications (BM/C³) functionality for operational deployment as part of an evolutionary acquisition approach to meet the requirements of the Global Protection Against Limited Strikes (GPALS) System. This process will be used to ensure that the C²E critical design characteristics and operational capabilities can execute the United States Space Command (USSPACECOM) Ballistic Missile Defense (BMD) Concept of Operations (CONOPS). Additionally, the C²E evolutionary acquisition process will: demonstrate that critical BM/C³ technologies can be incorporated into the open architecture; prove that critical BM/C³ processes are understood and attainable; develop BM/C³ information to support the GPALS BM/C³ MDAP Milestone II documentation requirements; and establish the GPALS C²E baseline cost, schedule and performance objectives.

The C²E provides USCINCSpace with the capability to plan, command and control BMD operations. The C²E is a distributed, informed system consisting of processors, software, man-machine interfaces, and communications media.

The C²E consists of three sub-elements that will be integrated to provide the GPALS System BM/C³ capability. The Command and Control (C²) sub-element consists of human-in-control decision support processes that enable USCINCSpace to select and issue the system control directives required to operate and maintain control over the GPALS System. The Engagement Planning (EP) sub-element is a set of automated processes which respond to the C² system control directives; allow data from different sensors to be combined or fused; task the communications network, the sensors and the weapons; and provide real-time performance summary data to assess performance. The sensors provide the data needed to detect, track, and classify the threat, and perform kill assessment; the weapons engage and negate the threat. The Communications sub-element provides the hardware and software resources and the network management necessary to securely send and receive information/data within the C²E, and between the C²E and other GPALS System elements.

The C²E Program will develop BM/C³ equipment for installation in the following operational facilities:

BMD Cell

This facility will be located in the USSPACECOM Consolidated Command Center (USCCC) and Space Control Center (SPACC) to support the Space Force Application mission area interface between the GPALS System and USCINCSpace. The BMD Cell will provide command and decision support to USCINCSpace.

Ballistic Missile Defense Operations Center (BMDOC):

Initially located at the NTF, and ultimately in the Cheyenne Mountain Complex, this facility supports the BMD Cell-USSPACECOM information interface. The BMDOC hosts a BM/C³ processing suite and the operations personnel necessary to coordinate and integrate system-wide BMD activities and supports the USCINCSpace planning and decision process.

Component Command Centers:

The Component Command Centers (which will contain Army and Air Force unique capabilities) will be capable of supporting the USCCC and distributed Operations Center by functioning as "Hot Backups". The BMD Cell and BMDOC capabilities will be replicated at the Component Command Centers to provide for BM/C³ availability and survivability. The Component Command Centers will be capable of executing real-time control of BMD engagement operations.

Operations Centers:

The C²E Program will deliver BM/C³ equipment to both the Element Operations Center (EOC) and Regional Operations Center (ROC) to support their control of weapon/sensor elements. The EOC and ROC will each host a BM/C³ processing suite and the operations personnel required to support the real-time control of BMD engagement operations.

PROJECT NUMBER: 2304
PROJECT TITLE: System Software Engineering
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

GPALS will require adaptive, fault-tolerant, reliable, trusted software that must be developed, integrated and tested across multiple systems and developers. This project will provide the capability to specify, develop, acquire, integrate, test, and maintain software for SDIO. Efforts underway to achieve these capabilities include proof-of-concept demonstrations; tools and methods analysis and development; software code prototyping; laboratory experiments; software contractor evaluations; and various analyses, investigations, and reports. Proof-of-concept demonstrations of formal methods for software development, demonstrating the production of code to Trust Level five, are expected during FY96. Build One of the SDI Software Engineering Support Environment (SESE) is scheduled for completion in FY95 with subsequent builds completed in FY96 and FY98. Efforts continue in the research and development of parallel processing technologies. Standards, products, tools, and methodologies developed under this activity apply to all SDI Element software development efforts and will provide the basis for coordinated and successful SDI software development, integration, testing, deployment, and maintenance.

PROJECT NUMBER: 3102
PROJECT TITLE: System Engineering
PROGRAM ELEMENT: 0603215C Limited Defense System
0603216C Theater Missile Defense

PROJECT DESCRIPTION:

The purpose of Systems Engineering and Integration is to develop the top level design of the Global Protection Against Limited Strikes (GPALS) System taking into account the threat and the user's requirements; allocate system level design requirements to elements; develop and maintain configuration of the GPALS system as it evolves; develop and design the GPALS Command and Control Element; insure that the inter-element design activities are fully integrated to complete comprehensive demonstration/validation (DEM/VAL) program. Meeting these objectives prepares the GPALS System for the engineering and manufacturing development (EMD) phase leading to fielding the segments of the GPALS system to meet its Theater, National, and Global missions. These objectives include maintaining a contingency for an earlier NMD UOES site fielding, if the decision is made during late DEM/VAL.

The Systems Engineering and Integration Contractor (SEIC), supporting the SDIO GPALS General Manager achieving the above objectives, is responsible for overall systems engineering and integration for the GPALS System and Strategic Defense, systems engineering for Theater Defense and the C²E interface with the TMD contingency operations through GPALS BMC³, integrated system/segment simulation, integrated systems/segments testing, and the development of the Battle Management, Command, Control, & Communications (BMC³) hardware and software. The SEIC is to consider all of the GPALS segments to ensure proper design to allow for system evolution and insertion of new technologies as they mature. This also includes coordinating interface requirements, managing GPALS' segment systems engineering, and providing engi-

neering guidance to program participants. The SEIC supports the General Manager as he works with the Service PEOs and PMs to fully implement the GPALS System controlled configuration into the Element contracts.

The current SEI contract was awarded competitively for five years through May 1993. An open competition for a BMC³/SE&I contractor will be held during FY93 with an award in the third quarter FY94 to carry the program through DEM/VAL and into EMD. The winning contractor will be accountable for all the responsibilities described above. This contractor will be required to accept total system performance responsibility within one year of the contract award. The current SE&I contract will be extended two years (with two one-year options) to insure the current specifications and databases can be properly transferred to the winning contractor. The hand-off between the extended current SE&I contract and the competed BMC³/SE&I contract insures that previously developed requirements and interfaces will be incorporated/updated as part of the continuous development. The new contract will be for the duration of DEM/VAL (approximately 5 years) with an option for EMD (up to 5 years). The Element contractors will establish an associate contractor relationship with the winning BMC³/SE&I contractor.

PROJECT NUMBER: 3103
PROJECT TITLE: SDIO Metrology
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

The Metrology effort is performed at the National Institute of Standards and Technology facilities in Gaithersburg, MD and Boulder, CO. This project addresses the identification and development of critical measurement standards, unique to SDIO requirements, which are inadequate or non-existent at the U.S. National level. These standards will provide the legal and scientific basis for measurement of performance of SDIO system parameters. This effort also integrates and manages the SDIO software producibility Manufacturing Operations, Development and Integration Laboratory (MODIL) network.

PROJECT NUMBER: 3104
PROJECT TITLE: Integrated Logistics Support
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

The Integrated Logistics Support (ILS) project addresses the identification and quantification of the essential elements of a Global Protection Against Limited Strikes (GPALS) support system. It identifies the basic supportability costs, schedule, performance, and support technology drivers in each SDI project to ensure the minimum cost of ownership and maximum effectiveness of the GPALS system.

PROJECT NUMBER: 3105
PROJECT TITLE: Producibility And Manufacturing (P&M)
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

This project will identify P&M risks and develop generic risk mitigation programs associated with the producibility and manufacturing needs of the designs of the Global Protection Against Limited Strikes (GPALS) National and Theater Missile Defense elements (including User Operational Evaluation System) and will coordinate and implement a structured, unified approach to risk reduction and mitigation of common P&M issues.

The approach involves the following five efforts:

1. **Manufacturing Strategy Development.** This effort develops and implements a capstone Strategic Defense Initiative Manufacturing Strategy (based on the revised DoDD 5000.1, DoDI 5000.2) providing leadership and direction as the Elements and Systems Engineer develop their manufacturing strategies. This strategy development will flow down to the Element Contractors and subcontractor levels.
2. **Industrial Resource Analyses (IRAs).** Analyses and risks of the shortfalls of industry's capability and capacity to manufacture key element design technologies.
3. **Initiating critical producibility programs with industry in a number of high-priority areas to complement on-going Technology or Element P&M efforts and to address Segment P&M Exit Criteria.**
4. **Manufacturing Operations Development and Integration Laboratories (MODILs).** MODILs serve to address and ultimately mitigate high producibility risks. This involves accelerating the development, integration, and introduction of modern, cost-effective manufacturing technologies into each elements' design and the industrial base using existing national resources (government labs, industry, academia). Existing MODILs are integrated by National Labs (Survivable Optics - Oak Ridge National Lab, Electronics & Sensors - Sandia National Lab, Spacecraft Fabrication & Testing - Lawrence Livermore National Lab) and NIST - the Software Producibility MODIL.
5. **Coordinating and leveraging SDI investments with DoD Industrial Base programs, and DDR&E Advanced Technology Demonstrations.**

These efforts combine to assure that commitment and emphasis will be placed on risk reduction and design-for-manufacturability during the appropriate design or development phase.

PROJECT NUMBER: 3107
PROJECT TITLE: Environment, Siting and Facilities Activities
PROGRAM ELEMENT: 0603218C Research & Support

PROJECT DESCRIPTION:

Provide area narrowing and site selection support, environmental impact analysis documentation and facility acquisition support for the SDIO systems and technical development projects. Plan, program, budget, and monitor facility acquisition of Military Construction projects. Provide guidance and prepare Environmental Assessments and Environmental Impact Statements, as applicable, for SDIO technology demonstrations and test and evaluation activities. Develop guidance for Executing Agents on facility acquisition and environmental matters. Execute MILCON design for deployments and technology programs. Execute minor MILCON construction projects to support deployments and technology programs.

PROJECT NUMBER: 3108
PROJECT TITLE: Operational Environments
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

The purpose of this project is to identify, integrate, coordinate, and resolve natural and nuclear environmental issues. The program will focus on characterizing natural, debris, engagement and nuclear environments from a systems perspective. DoD and DOE programs will be reviewed to identify specific areas where additional effort is needed to support deployment/operation of a GPALS system, thus providing an adequate understanding of natural, debris, and potential nuclear environments within which a missile defense system must operate.

There are two main efforts ongoing within this project: (1) the KEW Space Debris Modeling effort, in which the Debris Radiance (DEBRA) model and a long-term DoD model of the space debris environment (Debris Analysis Workstation, or DAW) are being developed; and (2) the Nuclear Effects Physics Modeling effort, in which first-principle physics satellite nuclear radiation codes are being upgraded to provide higher-fidelity, faster-running trapped radiation transport codes.

The objective of DEBRA is to model KEW engagement scenarios from a sensor discrimination viewpoint. The objective of DAW is to provide a platform containing a standardized set of empirical software codes capable of performing on-orbit event analysis, pre-test intercept breakup predictions, and long-term flux predictions. Both DEBRA and the nuclear effects codes, with associated documentation, will be delivered to SDIO's National Test Bed (NTB) for use in assessing system survivability of GPALS space assets. DAW is planned for delivery to the Consolidated Space Test Center (CSTC) Space Test Range and the Air Force Operation Test Center (AFOTEC) for use by range safety when conducting SDIO intercept tests; and to AFSPACECOM and USSPACECOM for use in analysis of on-orbit break-up events.

Appendix

PROJECT NUMBER: 3109
PROJECT TITLE: System Security Engineering
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

The objective of the project is to ensure that Electronic Information Systems Security (ELIN-FOSEC) is integrated into the Global Protection Against Limited Strikes (GPALS) program, including the National Missile Defense (NMD) and Theater Missile Defense (TMD) programs. The System Security program will counter existing and everchanging electronic information threats, ensuring that the system is secure and will withstand any credible penetration or disruption attempts. The areas of security technology and support include: security architecture of the NMD, communications security (COMSEC) mechanisms, computer security products, trusted software, secure hardware and support of DEM/VAL activities and the National Test Bed (NTB).

PROJECT NUMBER: 3110
PROJECT TITLE: Survivability Engineering
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

The System Survivability Program is responsible for oversight and management of the GPALS Survivability Program. This oversight activity includes coordination of the SDIO's survivability-related activities to support the GPALS acquisition process, ensuring that proper interfaces are established and maintained within system, element and component levels of the Program.

The Program provides for generation of system and top-level element survivability requirements that are directly traceable to SDIO-approved mission requirements and threat scenario(s). Analyses are performed to support TMD, GMD and NMD. These analyses include performance of system-level trade studies to assess the ability of the system and elements to survive and operate in natural (e.g., debris) and manmade hostile (e.g., nuclear, laser, ASATs) environments. Additionally, the System Survivability Program ensures elements' survivability design concepts are consistent with survivability requirements and segments/elements are prepared for DAB and other critical reviews. The Program is also responsible for defining requirements for and performing system-level survivability-related tests, namely through SDIO's test beds within the National Test Bed (NTB). This includes defining system survivability test requirements as inputs to the SDI test and evaluation planning process. Finally, the Program is responsible for defining and assessing critical survivability-related operational concepts that are consistent with system and element survivability requirements, that enhance the system/elements' survivability, and that provide maximum flexibility to the User.

PROJECT NUMBER: 3111
PROJECT TITLE: Surveillance Engineering
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

In all mission areas and phases of the Global Protection Against Limited Strikes (GPALS) System, some level of target surveillance/ discrimination capability will be needed in order to meet mission discrimination requirements. However, surveillance/discrimination, to include bulk filtering, track initiation, tracking, track correlation, discrimination, and sensor management, is one of the most difficult and fundamental problems facing GPALS. This problem will also become more complex in the future as target decoy technology improves and is acquired by potential threats. This program addresses a wide range of surveillance/discrimination issues from a systems perspective and develops and evaluates algorithms and systems schemata to meet mission requirements by efficient use of available sensing resources. To accomplish this, this program has developed a simulated test environment known as the Surveillance Test Bed (STB). The STB is one of several test beds that will be resident on the National Test Bed (NTB). The STB provides the capability to evaluate element algorithms or Test Articles (bulk filtering, tracking, discrimination, etc.) and system schema (the framework that integrates elements and algorithms into a coordinated system) on a high fidelity simulation of element sensors. In addition to the STB, other lower fidelity software tools will be utilized to conduct analysis and identify scenarios to be evaluated with the STB. This program will also develop and implement a methodology for validation of system level discrimination performance, including performance of system discrimination schema and algorithms in wartime environments. Close coordination is maintained with the Discrimination Technology project (#1105). Discrimination algorithms developed under that project will be evaluated and validated.

PROJECT NUMBER: 3112
PROJECT TITLE: Systems Engineering Modeling
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

The systems engineering support will provide critically needed capability to develop and use test beds and other models/simulations in support of the design and validation of Strategic Defense System (SDS) concepts. State-of-the-art test beds, models/simulations, and analysis tools are being developed in support of studies and analyses conducted prior to the Milestone II engineering and manufacturing development decision. These tools will support the SDIO community in evaluation/comparison of alternative architectures and support element model development/integration. In general, system engineering support will include: design, development, integration, test, and maintenance of Level Two System Simulators (L2SS); design and development of Command and Control simulators (C² Sims) supporting USSPACECOM and component commands' Concept of Operations Exercises (CONEXes); and development and operation of the NTF's Center for Software Engineering and Technology (CSET).

Appendix

PROJECT NUMBER: 3113
PROJECT TITLE: Ground Common
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

Provide environmental impact analysis documentation, deployment siting and basing analysis, and facility acquisition support planning of the SDIO National Missile Defense (NMD) and Global Missile System (GMD) systems and technical development projects. Plan, program, budget site specific Environmental Assessments, Environmental Impact Statements, and Environmental Mitigation actions, as applicable, for SDIO NMD and GMD common facilities design and construction activities. Develop guidance for Executing Agents on facility acquisition and environmental matters. Provide common facilities, equipment such as vehicles, support equipment, test equipment, computers and tools.

PROJECT NUMBER: 3201
PROJECT TITLE: Architectures And Analysis
PROGRAM ELEMENT: 0603215C Limited Defense System
0603218C Research And Support Activities

PROJECT DESCRIPTION:

This project develops, evaluates, and compares alternative architecture concepts for all phases of the Strategic Defense System (SDS), including Limited Protection Systems (LPS), Global Protection Against Limited Strikes (GPALS), and Follow-on Architectures. Emphasis is on the insertion of newly emerging technologies into the system elements to reduce system cost and increase effectiveness. Additional areas of investigation include new and innovative concepts, implications of new technical concepts, and architectural effects of specific technical issues. This project also prepares cost and operational effectiveness analyses for strategic defense major defense acquisition programs. Includes upgrading and maintaining simulation tools which are necessary to conduct architectural level analyses, such as the Mission Effectiveness Model (MEM). Element task areas are: Follow-on Architecture Analysis, Alternative Architectures, and Analysis Tools. The Mission Analysis function provides direct support to the Director, SDIO, and senior OSD policy officials on a variety of sensitive policy and strategy issues, including implications of events in Russia and other members of the Commonwealth of Independent States (CIS) for the SDIO/GPALS program; the status of formerly-Soviet offensive ballistic missile capabilities; arms control; strategic stability and deterrence; and proliferation of nuclear weapon and ballistic missile technology in the rest of the world.

PROJECT NUMBER: 3202
PROJECT TITLE: Operations Interface
PROGRAM ELEMENT: 0603215C Limited Defense System
0603218C Research And Support Activities

PROJECT DESCRIPTION:

The mission of the SDI Organization is to support national security policy and strategy and to manage the development and deployment of a ballistic missile defense (BMD) system that meets the operational mission requirements of the designated users of that system. In support of this mission, analyses and simulations focus on definition of the GPALS concept, coordinating and refining the concept definition with other parts of DoD, external agencies, and (indirectly) with Allies and friends who may cooperate in mutual deployments of a BMD system. Analyses and simulations address strategic and tactical effectiveness, including offense-defense interaction of proposed GPALS system architectures against offensive ballistic missile threats to the U.S., our Allies and friends, and deployed forces. Analytical results are then used to support activities required for the Defense acquisition process. Funds are also provided from this project to operational users (USSPACECOM, ARSPACE, AFSPACE, NAVSPACE, Marines, SAC/STRATCOM) to enable them to develop their operational requirements and concepts of operations for employing BMD and ensuring that these concepts are integrated into the overall BMD system deployment strategy and planning.

PROJECT NUMBER: 3203
PROJECT TITLE: Intelligence Threat Development
PROGRAM ELEMENT: 0603218C Research And Support Activities

PROJECT DESCRIPTION:

The purpose of the SDI Intelligence Threat Development project is to provide an up-to-date Intelligence Community-validated threat description against which system-specific threat-driven specifications, lethality designs, and target objects are developed. The primary vehicle for providing these threat descriptions is the System Threat Assessment Report (STAR), which is updated and validated by the Intelligence Community annually under this project. The STAR addresses the threat faced by a Global Protection Against Limited Strikes (GPALS) system from two points of view. First, the descriptions of CIS/Russian and Chinese threat vehicles, warheads, and penetration aids (Pen aids) are provided which apply to limited or all-out strategic nuclear attack against U.S. assets. Second, Rest-of-World (ROW) threat descriptions are provided that address the attack of overseas theater (tactical) resources of the U.S. and its allies. In addition to the STAR, six annexes, one for each Major Defense Acquisition Program (MDAP), are provided and validated by the intelligence community each year. The annexes contain somewhat more information than the STAR and are system-specific to each MDAP. The Intelligence Threat Development Program divides the threat into three major categories-Operational Threat Environment, Targets, and System Specific Threats. The Operational Threat Environment includes assessments of the socio-political, military and economic limits on the use of threats in attack scenarios and projects the force structure or order of battle for adversarial forces. The Targets include delivery vehicles and payloads, while the System Specific Threats include physical negation threats (both KEW and DEW) and nonlethal threats like electronic warfare and various forms of INFOSEC. The delivery vehicle category includes ballistic missile boosters and aerodynamic missiles residing within the

Appendix

Commonwealth of Independent States (CIS), CIS post-boost vehicles (buses), and ROW missiles (ballistic and aerodynamic) with ranges greater than 30 kilometers. The payload category includes CIS re-entry vehicles (warheads) and penetration aids, and ROW missile warheads (both nuclear and non-nuclear) and their penetration aids. Both targets and system-specific threats are described to three levels of detail. The threats are described at the highest level in terms of basic capabilities and country-of-origin (Level 0); form, fit, and function (Level 1) necessary to support system level trade-off studies; and the very detailed Level 2, where actual materials and structures are described for use in lethality studies, detailed element subsystem designs, and actual target designs. The analyses will evaluate emission signatures, reflection signatures, dynamic signatures (trajectories and microdynamics), and the system specific vulnerabilities for strategic and theater elements of GPALS. These analyses will provide detailed data for developing both theater defense systems and other GPALS systems.

PROJECT NUMBER: 3204
PROJECT TITLE: Countermeasures Integration
PROGRAM ELEMENT: 0603218C Research And Support Activities

PROJECT DESCRIPTION:

The mission of the SDI Countermeasure Integration (CMI) Program is to stress GPALS architectures and elements to ensure that deployed ballistic missile defense systems are robust to potential countermeasures which are within the means of anticipated adversaries. Included in this mission is a twofold responsibility. First, the CMI program supports the SDI threat development process by stimulating the examination and assessment of all credible counters to future deployed systems. Secondly, the CMI program provides the GPALS system designer with advance warning necessary for building preplanned improvements and program hedges into the design.

The SDIO CMI Program carries out its mission by pursuing the following objectives: identify potential countermeasures; determine credibility through analyses and tests; characterize credible countermeasures by providing designs and performance parameters; inform intelligence and system threat developers of potential countermeasures; and inform GPALS system designers with advance warning of potential countermeasures. These last two objectives represent the cardinal goals of the program. The support provided by the CMI Program to the threat development process and its outcome is the chief means by which the program achieves its mission of ensuring the robustness of future deployed systems. Making vulnerability and susceptibility information available to the system designers provides a mechanism by which the designers can build robustness into their designs during early stages of the system development process. The ability to improve the robustness of the design in its formative stages provides a cost-effective means of ensuring a flexible, high performance design. Timely screening of countermeasures also allows the system designer to focus on the critical countermeasures and safely ignore countermeasures which ultimately prove to be technically, politically, militarily or economically infeasible.

The CMI Program uses three primary resource groups to execute the process of countermeasure identification, analysis, verification and assessment. These three resource groups are the Red Teams, laboratories, and strategic analysis groups. Red teams are formed and tasked to identify and analyze potential countermeasures to a GPALS architecture or element. The laboratories and the contractor are responsible for verification of the technical feasibility of potential countermeasures.

asures. The strategic analysis groups provide assessments of the reality of potential countermeasures within the total context of the adversary's environment. Through this framework, the CMI program is able to access an array of countermeasure evaluation resources from government agencies, national laboratories, and contractors.

Over the course of the next several years, the CMI program will be conducting susceptibility studies of NMD systems and architectures. Plans call for Red Teaming system elements and publishing the results of those activities. Those concepts that appear to be viable counters to missile defense will be analyzed and tested. In addition, studies of possible Russian/CIS responses to U.S. missile defense developments will also continue in light of recent arms control agreements.

PROJECT NUMBER: 3206
PROJECT TITLE: System Threat
PROGRAM ELEMENT: 0603218C Research And Support Activities

PROJECT DESCRIPTION:

With the changing world situation and the projection of continuing proliferation of ballistic missiles, it is imperative that an accurate characterization of theater, national, and global threats be developed. The accurate specification and characterization of ballistic missiles and the appropriate development and integration of scenarios using these characterizations is critical to: (1) the analysis of alternative ballistic missile defense architectures; (2) the performance assessments of potential technology applications; and (3) the operational performance evaluations of candidate designs. The threat specifications and characterizations must be based on accepted intelligence community threat projections or realistic estimates of technological/operational innovations; be traceable back to objective and quantifiable analyses; and be supported by the using organizations. These threat projections, described in engineering terms and parameters, must be used by all SDIO agencies to ensure that results can be compared and contrasted.

The System Threat development project is an integral part of SDIO's three-part Threat Program. The System Threat Project uses as a baseline the System Threat Assessment Report (STAR) developed under the Intelligence Threat Development Project (#3203) and incorporates likely adversary countermeasures identified in the Countermeasures Integration Project (#3204). The System Threat Project adds system-specific engineering characterization details described in the form of scenarios characterizing particular timing, targets, and tactics.

The System Threat Project achieves its objectives through the auspices of the Threat Working Group (TWG), and the TWG subgroups (the Scenario Working Group (SWG) and the Penetration Aids Panel). The TWG, and the TWG subgroups, include representatives from: the Intelligence Community (DIA, CIA, Service Science & Technology centers, etc.); the SDIO and Service element development offices; the using commands (USSPACECOM, USASDC, USAFSSD, etc.); and the Service engineering support agencies. Using the expertise available through the TWG, the System Threat Project:

- (1) Identifies user needs for threat scenario descriptions.

Appendix

- (2) Identifies analyses needed to fully specify and characterize the threat missile systems, penetration aids, tactics, etc. and ensures the analyses is done.
- (3) Provides the analysis results to all interested agencies for review and comment.
- (4) Addresses critical threat issues which arise during the analysis process.
- (5) Ensures all supporting agencies' views on threat issues are fully aired.
- (6) Reviews, approves, produces, and distributes all System Threat Scenario Descriptions.
- (7) Produces threat computer tapes and supporting documentation for use by the development and acquisition communities.

The System Threat Scenario Description Documents are presented to the SDIO System Design Board (SDB) for endorsement and configuration control.

PROJECT NUMBER: 3207
PROJECT TITLE: Systems Analysis
PROGRAM ELEMENT: 0603215C Limited Defense System
0603216C Theater Missile Defense

PROJECT DESCRIPTION:

The objective of this project is to define an evolving architecture for the phased deployment of the GPALS defense system. The emphasis will be on the Limited Defense System including initial deployments. Critical systems issues will be resolved through analysis. This project will also define how Theater Missile Defense (TMD), Space-Based Interceptors (SBI), and Other Follow-On Systems will be integrated into GPALS. This project will provide recommendations on System Elements, command and control, battle management, acquisition strategies, and deployment basing. This project will also provide inputs to element requirements, Cost and Operational Effectiveness Analysis (COEA), and other required acquisition documents.

PROJECT NUMBER: 3301
PROJECT TITLE: SDIO Test Data Centers
PROGRAM ELEMENT: 0603215C Limited Defense System
0603217C Other Follow-On Systems
0603218C Research And Support Activities
0603216C Theater Missile Defense

PROJECT DESCRIPTION:

This project provides for the coordination, support, and sound management of data resulting from SDI Test and Experiments. These activities affect decisions with respect to the entire SDI Program, and, as such, are funded across several SDIO Program Elements.

The above objectives are accomplished through tasks which provide for the operations and maintenance of SDIO Test Data Centers and technical coordination and oversight activities. Data management, coordination, and oversight responsibilities are executed so as to satisfy Federal regulations, directives, and guidelines, and industry standards.

Each of the Data Centers catalog, archive, process, maintain, distribute, and provide controlled access to SDIO test and experiment data. Their mission is to serve as the principal repository for SDI experiment data, and to assist the analysis and science community with their requirements for the information to evaluate SDI feasibility, design development, and deployment. Additionally, the Centers provide specialized data products and analysis support for SDIO System Elements. Each Data Center is located at a DoD center of expertise in science/technology and utilizes this capability to assist analysts in the understanding of the data.

The oversight and coordination tasking supports the SDIO Data Center Program Manager (DCPM) and the SDIO Test Data Centers. Activities include coordinating issues relevant to Data Center tasking, providing technical analysis and recommendations, helping to ensure that Federal data management requirements are satisfied, and assisting the DCPM with the oversight of the SDIO Test Data Centers.

PROJECT NUMBER: 3302
PROJECT TITLE: System Test Environment
PROGRAM ELEMENT: 0603215C Limited Defense System
0603218C Research And Support Activities

PROJECT DESCRIPTION:

The mission of the Strategic Defense Initiative (SDI) National Test Bed (NTB) Program is to provide a comprehensive capability to experiment and evaluate alternative SDI system concepts; architectures, including battle management/command, control and communications (BM/C³); and key defensive technologies. The NTB consists of a network of integrated, geographically distributed, simulation and support facilities. The National Test Facility (NTF) at Falcon AFB, CO is the hub and central experiment and simulation facility. This project consists of the acquisition, operation and maintenance of computing and communications networks, secure facilities, and technol-

ogy required to support the NTB mission. The network nodes include SDIO, Army Space and Strategic Defense Command, Air Force Space and Missile Center, Air Force Electronic Systems Center, STRATCOM, Los Alamos National Laboratory, Naval Research Laboratory, General Electric Corporation - Blue Bell, PA, Army Space Command, The Analytical Sciences Corporation - Arlington, VA, Martin Marietta Corporation - Littleton, CO, Air Force Space Command, JCS/J8, BDM - McLean, VA, Booz Allen Hamilton - Crystal City, VA, and W.J. Shaeffer - Chelmsford, MA.

PROJECT NUMBER: 3303
PROJECT TITLE: Test and Evaluation (T&E) Planning
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

Provides independent T&E oversight and assessment of all GPALS system, segment, and element tests to ensure that comprehensive T&E programs are resourced and implemented to support GPALS-wide T&E programmatic and technical management, verification, validation and accreditation (VV&A), status monitoring, and coordination of planning to support SDI test programs, and test and development items to include: test beds, targets, test instrumentation, and system models and simulations.

PROJECT NUMBER: 3304
PROJECT TITLE: Targets
PROGRAM ELEMENT: 0603215C Limited Defense Systems
0603214C Space Based Interceptors
0603216C Theater Missile Defense

PROJECT DESCRIPTION:

This task provides for overall coordination of targets and target support throughout the SDI Program and, as such, is funded across several Program Elements. Currently, three tasks are included in this project: the SDIO Targets Program Space Test Range, and Studies and Analyses.

The objective of the Targets Program is to provide engineering and threat representative test targets for experiments and for Developmental/Operational Test (DT/OT) for the GPALS program. These targets must meet SDS performance, engineering, and threat characteristics requirements to provide test articles that will adequately emulate the expected threat and support engineering and development tests. Test and Evaluation is the staff function designated to provide for the design, development, characterization, validation, production, acquisition, and support system tests. The targets of concern are Boosters, Re-entry vehicles (RV), Post Boost Vehicle (PBV), Decoys and Penetration aids (PENAIIDS).

Targets will be designated and developed based on element and system level development test/experiment requirements. Initial target design and development will include an engineering and threat representative target set approved by the Test and Evaluation Working Group (TEWG), and

validated by the intelligence community. Testing will be conducted on the test targets to ensure that they meet the characterization and validation requirements of the standard/threat target set. This characterization will ensure the proper data is available, post test, for accurate and timely test evaluation.

Products resulting from this effort will include:

- Pre-production prototypes (target booster, PBVs, Rvs, Decoy/Penaid)s)
- Flight qualified hardware
- Pre-production, validated test articles (PBV/RVs, Penaid/s/Decoy/s) for GBI, MSX, Patriot, ERINT, THAAD BGR
- Launcher Boosters (Minuteman, STARS, sounding rockets)
- Range Telemetry Communication Equipment and sensors for data collection and characterization

PROJECT NUMBER: 3306
PROJECT TITLE: Computer Resources And Engineering
PROGRAM ELEMENT: 0603215C Limited Defense System
0603218C Research And Support Activities

PROJECT DESCRIPTION:

This project provides funding for the Advanced Research Center and Simulation Center (ARC/SC) for ongoing operations and maintenance in support of Ground Based Elements (GBE). The ARC/SC is an advanced computation technology system providing the operational test bed for resolving weapons, sensors, and battle management, command, control and communications (BM/C³) issues for strategic and theater defense. The ARC/SC also serves as a development and test capability for other USASSDC programs, to include the Surveillance Test Bed (STB), Extended Air Defense Test Bed (EADTB), Ground Based Radar (GBR) Test Facility, Midcourse Data Center (MDC) and Kinetic Energy Weapon Data Center (KDC). The ARC/SC is a major node in the National Test Bed (NTB).

PROJECT NUMBER: 3307
PROJECT TITLE: Airborne Surveillance Testbed (AST)
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

Appendix

The Airborne Optical Adjunct (AOA) program was reconfigured to use the AOA as an Airborne Surveillance Testbed (AST) to conduct experiments that will help GPALS elements resolve critical system and optical sensor issues throughout all phases of a ballistic missile trajectory. The AST program provides for the design, fabrication, integration, and operation of an advanced infrared (IR) sensor. The IR sensor, together with the data processing, display control, communications, and ancillary equipment, is installed on a modified Boeing 767 commercial aircraft. The AST sensor system is the most complex system of its kind ever built. It fulfills the demands for accurate and reliable performance and gathers data critical to SDIO. It collects multi-target signatures, verifies sensor technical and functional requirements, and validates signal and data processing techniques and algorithms. The major issues to be addressed by the AST are bulk filtering, track, sensor-to-sensor correlation, resolution of closely spaced objects, discrimination, handover to other sensors, and signal and data processing requirements for IR sensor performance. The AST provides a design and performance data base for on-going as well as future programs in the areas of optical sensor and signal processor design, system performance and operation of IR sensors, real-time on-board signal and data processing, performance of an integrated IR sensor system, and target signatures. The operation of the AST sensor system provides information essential for risk reduction and effective design of future optical surveillance systems. Initially, the AST subsystems were tested at ground facilities. After integration on the aircraft, the integrated system was tested in flights over the Continental United States (CONUS). Currently, the AST is being used in support of: SDIO technology experiments to collect key optical data and perform functional demonstrations; Live Flight Integration Experiments (LFIE); and NMD System Integration Tests (SIT). The tests/experiments are being conducted at United States Army Kwajalein Atoll (USAKA), WSMR, ETR, and other national test ranges as well as Rest of World (ROW) locations.

PROJECT NUMBER: 3308
PROJECT TITLE: System Simulator
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

System simulation in the form of the Level Two System Simulator (L2SS) is being developed to provide end-to-end analysis capabilities which is based on the current Global Protection Against Limited Strikes (GPALS) architectural requirements. L2SS will provide a digital high fidelity design with specific representation of the system while retaining some architectural configuration flexibility. The cognizant services and Element Program Offices are directly responsible for the development of their simulated models. These will be integrated into a common simulation framework at the National Test Facility. Simulation is a critical exercise in the engineering and integration process of a system and its interfaces, in that the L2SS spans multiple development agencies and will precede the availability of hardware components by several years. Important lessons on developing and integrating a large software project by different agencies will be tracked and distributed. System simulation is expected to play a crucial role in both making design related decisions during the engineering process as well as during the formal testing of the system.

PROJECT NUMBER: 3309
PROJECT TITLE: System Test Planning And Execution
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

The objective of this project is to provide "system-level" test planning and execution for development testing (DT) for the GPALS system and its system-level segments. Element developmental test and evaluation (DT&E), however, remains the responsibility of the element program manager, as does element-to-element interface testing. This project supports both the SDIO and service system-level DT. Funding for operational test (OT) planning is also provided under this project for consistency with prior years, but is being transitioned this fiscal year to a new and separate project (3314 Operational Test Support).

System level testing will consist of three related efforts: 1) extraction and augmentation of system data from element DT contractor and government tests to meet system test objectives as defined in the System Test Plan; 2) augmentation of a series of Live Flight Integration Exercises (LFIE) and System Integration Tests (SITs); and 3) completion of system-wide GPALS simulations in a real-time Integrated System Test Capability (ISTC). System test planning also includes planning for DT&E events in the GPALS Engineering and Manufacturing Development (EMD) phase in sufficient detail to define the resources and provide those top-level test plans to support Milestone reviews and to scope EMD Statements of Work.

When SDIO sponsored system level tests augment element and inter-element tests to collect system data or satisfy "system" test objectives, this project will fund the system-level incremental delta test costs, i.e., additional planning, instrumentation, test time, data analysis, and evaluation, over and above the basic element test costs. Certain tasks are related, but not included; i.e., Service element DT. The NTF is separately funded through its own project. Further, Allied tests are not included.

PROJECT NUMBER: 3310
PROJECT TITLE: Test And Evaluation Facilities/Launch Support
PROGRAM ELEMENT: 0603215C Limited Defense System
0603216C Theater Missile Defense

PROJECT DESCRIPTION:

This task provides for overall coordination of centrally managed test facilities throughout the SDI Program and, as such, is funded across several Program Elements.

The objective of this project is to provide adequate, common-user test and evaluation (T&E) facilities to enable SDIO test and experiment programs to meet their objectives. This is the first year these projects are consolidated for management purposes; the plan is to further consolidate management for other multi-user facilities in future years. Prudent consolidation can enhance efficiency and economy while satisfying user requirements. Facilities requirements will be satisfied using existing resources whenever possible. New and upgraded facilities will only be pursued

Appendix

when no existing capability will meet basic requirements. This project includes the following facilities: the Center for Research Support (CERES), Kinetic Energy Weapons Digital Emulation Center (KDEC), Aero-Optical Evaluation Center (AOEC), National Hover Test Facility (NHTF), and Kinetic Kill Vehicle Hardware-in-the-Loop (KHILS), and the NSWC Hypervelocity Tunnel 9 Facility.

PROJECT NUMBER: 3311
PROJECT TITLE: Mobile Test Assets
PROGRAM ELEMENT: 0603215C Limited Defense Systems
0603217C Other Follow-On Systems

PROJECT DESCRIPTION:

This task provides for overall coordination of test mobile assets throughout the SDI Program and, as such, is funded across several Program Elements.

This project allocates resources to develop, operate, maintain, and upgrade SDIO mobile test assets. SDIO test and technology experiment programs require adequate test resources, ranges, monitoring and data collection to accomplish their test objectives. When existing ranges/launch locations and fixed facilities do not have sufficient capability to support SDIO test and experiment requirements, mobile assets will be programmed consistent with overall T&E requirements. This project currently supports the range support ship, USNS Redstone and High Altitude Observatory (HALO) aircraft. In subsequent years the plan is to consolidate other common user mobile test assets under this project. The USNS Redstone and her electronic system, the M247 Flight Test Support System, were specifically designed and developed by the Navy Strategic Systems Program for supporting TRIDENT flight test activity. It will be used to perform the range support mission for SDIO experiments for the Brilliant Pebbles (BP) tests, and Theater Missile Defense (TMD) tests where Wake Island serves as the target launch location. Wake Island has not traditionally been used as a range asset and is not equipped for this mission. Relocating the Redstone to the Western Pacific will satisfy this requirement in a cost effective manner.

PROJECT NUMBER: 3312
PROJECT TITLE: The System Test Environment Support Project
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

The System Test Environment Support project provides a critically needed capability to the SDI community in special studies and analyses, dealing with SDS, GPALS, and other alternative architectures, elements, technologies, interfaces, strategies, testing, and simulation/modelling. It continually performs time sensitive studies and analyses on SDI programs. Particular programs supported include: SDS Architecture Analysis; Element support--Brilliant Eye and Brilliant Pebbles; Technology Insertion--Multi-Level Security capabilities; Advanced Software and Hardware Initiatives; Quick Reaction Studies; and the Analytical Tool Box. The Analytical Tool Box provides the SDI community with a set of models, that the NTF has performed confidence assessment on, used to support decision making processes. The advanced hardware and software

environment initiatives meet near term requirements in Software Environment, Technology Insertion, Networking, Communication Center Upgrades and Security.

PROJECT NUMBER: 3313
PROJECT TITLE: Test Ranges
PROGRAM ELEMENT: 0603215C Limited Defense Systems
0603216C Theater Missile Defense

PROJECT DESCRIPTION:

The objective of this project is to provide adequate, common-user test and evaluation (T&E) ranges to enable SDIO test and experiment programs to meet their objectives. This is the first year these projects are consolidated for management purposes; the plan is to further consolidate management for other multi-user ranges in future years. Prudent consolidation can enhance efficiency and economy while satisfying user requirements. Range requirements will be satisfied using existing resources whenever possible. New and upgraded ranges will only be pursued when no existing capability will meet basic requirements. This project includes the following ranges: WSMR, USADA, Wake Island, ESMC LC-20, Rapid Optical Beam Steering (ROBS) support, Millstone Hill, Wake Instrumentation and KMR Instrumentation.

PROJECT NUMBER: 3314
PROJECT TITLE: Operational Test Support
PROGRAM ELEMENT: 0603215C Limited Defense System

PROJECT DESCRIPTION:

The objective of this project is to cover the activities to be performed by each of the services' Operational Test Agencies (OTA) that support operational test planning and execution for the GPALS system and its system-level segments. This project includes those activities to plan for and test associated software and actual element data processing hardware. This project also includes those activities necessary to assist other OTAs in the integration testing of system-level configurations.

Operational testing will consist of several related efforts: 1) Extraction of system OT data from element DT contractor and government tests to meet test objectives; 2) Extraction of inter-element integration test data from a series of Live Flight Integration Exercises (LFIE) and System Integration Tests (SITs); and 3) use of system-wide GPALS simulations in a real-time Integrated System Test Capability (ISTC). Operational test planning also includes planning for OT&E events in the GPALS Engineering and Manufacturing Development (EMD) phase in sufficient detail to define the resources and provide those top-level test plans to support Milestone reviews and to scope EMD Statements of Work.

Near term NMD OT&E objectives include the conduct of planning, the identification of OT&E resources requirements, and the identification of ISTC and SIT objectives for OT&E. For FY93, OT&E planning, resource and objectives identification for UTTMDS, PAC III and Corps SAM is

Appendix

addressed in Theater Missile Defense projects. Subsequent OT&E for UTTMDS, PAC III, and Corps SAM will be addressed in this project.

PROJECT NUMBER: 4000
PROJECT TITLE: Operational Support Costs
PROGRAM ELEMENT: 0603215C Limited Defense System
0603214C Spaced-based Interceptors
0603217C Other Follow-On Systems
0603218C Research And Support Activities
0603216C Theater Missile Defense

PROJECT DESCRIPTION:

This project provides program management, system engineering, and program control support common to all other projects within these PEs. Program management tasks include SDIO and Executing Agent central management functions, including those that support the Office of the Director, Strategic Defense Initiative and his supporting staff located within the Pentagon. Typical system engineering tasks include review and analysis of technical project design, development and testing, test planning, assessment of technology maturity and technology integration across SDIO projects; and support of design reviews and technology interface meetings. Program control tasks include assessment of schedule, cost, and performance, with attendant documentation of the many related programmatic issues. This project supports funding for personnel and expenses for travel (TDY), training, rents, communications, information management, utilities, printing, reproduction, supplies, and equipment.

PROJECT NUMBER: 4302
PROJECT TITLE: Technology Transfer
PROGRAM ELEMENT: 0603218C Research And Support Activities

PROJECT DESCRIPTION:

The Technology Applications Program was established in 1986 to make SDI technology available to federal agencies, state and local governments, and U.S. business and research interests. The objective of this program is to develop and support the transfer of SDI-derived technology to Department of Defense applications as well as to other federal, state, and local government agencies, federal laboratories, universities, and the domestic private sector.

PROJECT NUMBER: 4305
PROJECT TITLE: Miniaturized Accelerators For PET
PROGRAM ELEMENT: 0603217C Other Follow-On Systems

PROJECT DESCRIPTION:

The Positron Emission Tomography (PET) accelerator program, initiated in FY88 by Congress-

sional direction, is a research project that will reduce the size, weight, and cost of current particle accelerators used to develop radiopharmaceuticals for Positron Emission Tomography medical diagnoses.